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Panama Canal in Service

DECKED out with the flags of all nations and with a distinguished company on board, as befitted the occasion, the steamer Ancon, in the Government's Panama service, on Aug. 15 made the passage through the Panama Canal from deep water on one side to deep water on the other in 9 hr., thus opening the canal to commercial traffic. The formal opening has been set for next spring, though the disturbances in Europe have caused a temporary suspension of preparations for the event. On Aug. 16 four merchantmen and one yacht passed through the canal. Thus closes successfully the essential construction stages in a work that has cast great credit upon the American people and their engineers.

Economy of Intermittent Filters

REGRET was expressed in these columns some weeks ago regarding the expected abandonment by New Britain, Conn., of the intermittent sand filters for sewage disposal. The point of view was taken that it was regrettable that a natural resource of this kind was apparently proving inadequate for the solution of the problem in hand. At the same time it was suggested that the utilization of such areas was more economical than the use of intensive types of treatment, sprinkling filters being in mind in this connection. Those interested in the subject are referred to an article on page 225 of this issue, in which data are presented showing that both in first and in operation costs sprinkling filters are more economical than the older type of plant. Special attention is called to the matter here because there is no desire on the part of this journal to allow incorrect views to stand.

Gaging Flows Through Turbines

HYDRAULIC engineers are fully aware of the limitations of the current meter and the Pitot tube for measuring the discharge in determining the performance of waterwheels. Much interest attaches, therefore, to any method which promises more accurate and uniform results. The titration method, in which a chemical is mixed with the water, has been previously referred to in this journal, and since it promises well, considerable space is devoted in this issue to an abstract of a paper by Mr. Groat, who has been experimenting with the method for several years. Measurements conducted under his supervision recently are reported to have shown an accuracy within 0.1 per cent., which is entirely out of the question with other gaging methods. The difficulties connected with the chemical method are not entirely solved, the chief one being the securing of a uniform mixture of the chemical. This question is of such importance that it will be dealt with in an appendix to the second installment of the article, which will be published in the next issue of this journal. Hydraulic engineers would do well to give careful consideration to this method.

The Harvester Decision

IF big business were not very seriously engaged in other directions it would probably be worrying somewhat about the meaning of the decision in the case of the International Harvester Company. Without expressly discarding the "rule of reason," it has been decided that a company may be offensive to the anti-trust law even if it cannot be shown that it has engaged in unfair or oppressive practices, or in fact anything wrongful in the conduct of its business. It is only necessary to show, according to this decision, that a company violated the law in its original organization to the extent that it purchased and combined under one management companies that were competing at the time they were combined. The point that it seems worth while to emphasize in this connection is that organizations partaking of the nature of trusts which have been complimenting themselves that they were safe within the ramparts of the rule of reason are faced by the prospect that without regard to the extent to which they may be considered monopolies, and without regard to their method of conducting business, they may be haled before the courts for violation of the Sherman law.

Labor-Camp Sanitation

TO those who have not followed the march of events in the construction field the term "contractor's camp" brings up a picture of crowded, ill-smelling bunkhouses, the shanty saloon with its gang of lawless hangers-on, and a commissary, created not to supply nourishing food to men who work hard but to collect exorbitant tolls for life's necessities. Scenes of this sort are less common than they used to be. The New York Board of Water Supply on its Catskill Aqueduct work has given a convincing demonstration of how the construction-camp problem should be handled. But the effort to improve conditions is not confined to the East. The California Commission of Immigration and Housing has been studying the question and has issued recently an advisory pamphlet of 54 pages on "Camp Sanitation and Housing." Authorities everywhere should insist on the enforcement of sanitary camp rules on the part of all who maintain camp quarters, even though only a small number of men are involved. The policy of the State Highway Commission of California in this particular is exemplary. The issuing of the pamphlet indicates that throughout the State, hereafter, the importance of camp sanitation will be emphasized. Indeed, it is not a far cry to regulation by State authorities, to a certain degree, if there is persistent disregard of the suggestions which are being so carefully made. In New York the labor department is keeping a close watch on camps. The sanitary engineer will not find much, if anything, in the pamphlet which is new to his profession, except that it presents in very convenient form designs for sanitary camp structures. The most interesting point in connection with the pamphlet, however, is that it is a forward step calculated to spread the gospel of sanitation to quarters where attention to the matter is sorely needed.

"Clean-Up Week" Methods

PUBLICITY is a powerful weapon in the hands of those who know how to use it. The engineer has been notably slow in appreciating its possibilities. It will come as a surprise, therefore, to many to hear of a widespread publicity campaign in which engineers took a prominent part. At Philadelphia, in an effort to improve sanitary conditions and minimize the fire hazard, it was decided to inaugurate a "Clean-Up Week." The methods of conducting the campaign are described on page 226. Obviously a movement of this sort depends for its success not only upon the thoroughness with which the people are made acquainted with the work expected of them, but also upon the enthusiasm which can be aroused. Without the heartiest kind of co-operation any such plan will end in dismal failure. This is especially worthy of serious consideration in starting movements in large cities where it is not easy to arouse enthusiasm. It is interesting to learn how the Philadelphia committee went about its work and what results were accomplished. The shrewd engineer is beginning to realize that with the public back of him he can do many things which otherwise would prove difficult. The professional man has been loth to take the layman into his confidence, but times are changing and the trend is now in the other direction. Witness the popularity of the "Good Roads Days" throughout the Middle West and South. Another straw in the wind is the suggestion which Street Cleaning Commissioner Fetherston of New York made in his recent snow-removal report—to hold "snow-fighting bees" in which citizens would take part. At Dayton there has been launched a campaign by which it is hoped to induce citizens who travel to observe conditions outside of their home town and report upon them when they return. Even medicine and law are less reserved. The former as a preventive science is everywhere being taught. In all these efforts very important additional gains—which the engineer is apt to lose sight of—are the co-operative spirit and civic pride developed by participation in public work. The actual material accomplishments are well worth while, but probably in a historical review hardly less value will be attached to the growth in civic consciousness and pride.

Aftermath of Concrete Failure

PROSECUTION for criminal negligence in connection with concrete failures has been urged against the guilty parties. Such a demand is but natural at the end of almost any winter when the season's crop of failures is passed in review. That drastic action would be taken sooner or later to bring contractors and owners to a sense of their obligations in providing competent inspection on concrete work was not to be doubted. Los Angeles has done the expected in its new reinforced-concrete building ordinance, which went into effect July 1. It is provided therein that the architect, owner, builder or other person immediately in charge of construction shall retain an inspector competent to see that the provisions of the ordinance are complied with. Furthermore, it says that every such inspector who shall fail, refuse, or neglect to stop immediately the construction of any reinforced-concrete work that fails to comply with the requirements of the ordinance and immediately report any such violation to his employer and the Board of Public Works shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by a fine of not more than $500 or by imprisonment in the city jail for not more than six months or both.

This, evidently, is a very drastic measure. Nevertheless those who have followed closely the history of building failures in the winters of the last five or six years will feel that some such provision was inevitable. Whether it will stand remains to be seen. It seems to confuse private and police functions. It does not appear that the city's inspection force can be dispensed with on account of this provision; and while there would, therefore, seem to be a duplication of work, the other point of view is that it brings the judgment of two trained men to bear on the work instead of one. Moreover, the contractor will look more closely into the competence of his inspector. It will be well worth while to inquire of Los Angeles a year hence how its new ordinance has worked. Certainly all will agree that some measure was necessary, and since prevention is better than cure it would seem better to impose some such punishment as this rather than prosecute an owner or contractor for the lives lost on account of incompetence or negligence.

Response to South America's Call

NO single movement in America's commercial history can compare with the efforts now being made by American manufacturers to meet the demands of the South American countries. Quick to appreciate the opportunity afforded, while deploring the cause, they have set about actively to provide those essentials—a merchant marine and adequate banking facilities—without which the development of commerce with South America is unthinkable. Not a whit behind its citizens has been the Government itself, and no small meed of praise is due President Wilson and his advisers for the energy they have displayed in the present emergency. The series of measures adopted were briefly outlined editorially in this journal on Aug. 8. Since then Secretary McAdoo has met representatives of prominent exporting firms to discuss plans for facilitating the movement of American goods.

Aware of the importance of quick action at present, the Engineering Record has been looking into the possibilities for American trade expansion in South America and has brought together in this issue interviews with men who know the South American field and statistics indicating the value of engineering and construction materials and contractors' equipment sold by the leading European powers in 1912 to Argentina, Brazil and Chile, the chief purchasers on the South American continent. A careful study of this material, or even a hasty survey, will convince the most skeptical that never before has a similar opportunity been presented to American manufacturers. Fortunately, too, their equipment and resources are such that they are in a better position now than ever before to profit by the markets thus thrown open to them.

It need not be said, of course, that the capturing of this trade, even under the present favorable circumstances, cannot be accomplished without hard work and careful study. First of all, adequate banking facilities, as pointed out in the interview with Mr. Moyer, are absolutely essential. Fortunately one large New York banking institution has jumped into this breach, and undoubtedly other strong financial houses within a very short time will be able to extend to our manufacturers the credit facilities they need to carry on the South American business. Furthermore—and this should be most convincing as to the pressing needs of Latin America—the Argentine Government itself has taken a step to facilitate exchange with that country. As pointed out in the interview with Señor Naon, the Argentine Ambassador, the Government will receive payments in either country and cause to be issued proper bonds in the other which can be converted into funds.

The second great need is an adequate merchant marine, so that there will be sufficient carrying capacity for the trade between the two Americas. Here again South America is forehanded, since the Brazilian Minister of Finance has arranged to send four or five steamers of the Government line to New York with Brazilian products. Congress has been slow in its consideration of the new registry law, and only the bickerings of interests too selfish to consider the good of the entire country prevent more rapid enactment.

The third great need is the assumption by the Government of war risks. In this the European countries have already led the way and we may well profit by their example.

These three things being provided—banking facilities, an adequate merchant marine and Government insurance of war risks—there is no reason why a goodly share of the South American trade should not be ours. Details there are by the dozen which need consideration, but information as to many or all of them is at hand in the Bureau of Foreign and Domestic Commerce, at Washington, and in the Pan-American Chamber of Commerce, at New York. Information as to methods of packing, arrangement for foreign representation, prospective customers in South American states, present needs—these are all obtainable from the sources mentioned and from the consular offices of the South American republics.

Energy is needed, but that is an asset in which the American manufacturer and business man has never been lacking. Certainly its expenditure liberally is fully warranted by an opportunity which Julio F. Soranzo, president of the Pan-American Chamber of Commerce, says will permit us to accomplish in a few days what could not have been done in fifty or a hundred years had not the Continental conflict shown the way.

Training for Highway Work

IN an address before a recent meeting of the Institution of Municipal and County Engineers, Great Britain, H. Percy Boulnois, past president, advocated the establishment in the colleges of Great Britain of special courses in highway engineering. His argument was that the introduction of self-propelled traffic and of new types of road materials has raised highway work to a plane demanding the highest grade of engineering training. While experience after graduation will teach much, one's progress will be more rapid and his grasp broader if he has a grounding in the sciences which shed light on the materials he uses. Mr. Boulnois' views met with the endorsement of those who discussed his paper.

It is needless to emphasize that the same need for trained highway engineers has been felt in this country. Moreover, the colleges here are preparing to fill the need. Fortunately the flexibility of the curriculum in the later years of the technical courses in this country allows the ready substitution of highway studies for the usual electives. What is needed is not the production of chemists learned in the mysteries of bituminous materials or specialists with heads crammed full of road lore, but rather men broadly trained and equipped by severe mental discipline to grasp the technical and administrative problems which will confront them in highway work.

Their direct equipment will consist of a thorough understanding of what constitute the fundamentals of highway location, design and maintenance. With these as a foundation—a disciplined mind and a thorough grasp of engineering and highway fundamentals—the needed experience can be picked up as fast in the field as a man's aptitudes allow. Probably the best thing that the highway courses in the colleges can do for our young men at the present time is to awaken them to the opportunities offered by highway work throughout the country. Only within recent years has there been an appreciation of these opportunities, but even now they seem to be less highly regarded than are those in other branches of engineering. Possibly the same is true also in England. Once these opportunities are fully appreciated, the proper college facilities will be provided and the interest of the colleges will help to direct capable men toward the new courses and into the new work.

The Technical School and the State

THE Alumni Association of the Massachusetts Institute of Technology has taken up in earnest the subject of co-operation between that school and the Commonwealth of Massachusetts. Such co-operation has been a matter of course in Illinois, Wisconsin and Iowa owing to the close relations between the States and the great schools at Urbana, Madison and Ames, and this is true of conditions in some other Central States, although to a smaller degree. But along the Atlantic Seaboard a school has been regarded primarily and principally as an educational institution, and the help given to the State has been generally that of individuals rather than of schools. At the Massachusetts Institute the services rendered to the State Board of Health by President Rogers, Professor Nichols and Professor Sedgwick have not been regarded popularly as work done by representatives of the Institute but rather as assistance furnished by eminent specialists as private persons. The distinction between this condition and that in the three States just mentioned is wide and deep. The Alumni Association believes that this distinction is too great, that the Institute can and should be of greater aid to the Commonwealth, and it has suggested several ways for placing its resources at the disposal of the public.

The methods of co-operation which are proposed are based on the possession by the Institute of laboratories, libraries and a staff of specialists utilized at present to only a part of their full annual capacity in educational work. It is suggested, therefore, that the Institute might conduct the research work needed to determine standards which the regulations of State commissions on legislation may require; it might act as the technical counsel of the governor or the Legislature where questions of applied science arise, as they did in about 250 of the 850 acts and resolves of the Legislature of 1913; it might assign members of its staff to special work for the State, which would eliminate the difficulties of organizing a small, temporary staff for each such purpose; it could assist in the organization of permanent scientific staffs for State work, and finally it could have the results of researches of general use to the public published as State documents instead of remaining locked up in manuscript or occasionally seeing light in the journal of some society. This is only a part of the program which has been presented, but it reveals clearly the feeling that the Institute owes a duty to the commonwealth which it is discharging very poorly at present. It is this opinion that deserves most thought now, rather than the details of possible service.

Publicly supported technical schools of the Central States have had on their faculties for years many of the leading specialists in their respective territories. When technical subjects arose in legislative and administrative work it was natural, therefore, that they should be called upon for advice or services. In the Eastern States it was otherwise, for there has always been a goodly number of specialists in every line of applied science not connected with educational institutions. Furthermore, the feeling that schools were mainly for educational purposes was deep rooted. Consequently, in providing laboratories and instructors the aim was to furnish the greatest possible amount of instruction for the money available. Nevertheless, the feeling has been growing in recent years that the large institutions owe a duty to the State, and consequently we find faculty members from every department of the big institutions lending a hand in public affairs. As a rule, however, the co-operation is spasmodic and is still largely dependent upon the initiative of individuals rather than upon the initiative of the institutions as such.

The recent proposals of the Massachusetts Institute's alumni are particularly interesting as throwing light on this Eastern view of the public obligations of a technical school. In the large group of buildings now under construction on the bank of the Charles River Basin there will be laboratories, libraries and a personnel not utilized during a large percentage of the year. Idle plant is the bane of the successful technical man; his object is to keep everything busy on a profit-producing basis. The Institute has taught this, as have her sister schools, and now her graduates turn on their alma mater and propose to make her more efficient by utilizing the idle time of the plant and the present spare time of the teaching staff in the service of the Commonwealth. The basic thought is one which most technically educated men will approve, for the aid thus afforded to the public can be made of great value. But there will be a division of opinion as to the merits of any project which will obscure in the slightest degree the primary educational purpose of the Institute and the desirability of deepening and strengthening her educational molding of the young men under her charge.

Road Destroyers Must Pay

MORE in desperation than because it was considered wise policy a Parliamentary committee in England has approved a measure which will permit the collection of tolls on heavily traveled main highways. This return to an old order of things is justified by the fact that road users and not local communities must bear the ever-increasing burden of maintaining through highways. The motorbus, which in England to an even greater extent than here is ravaging the roads, is also to be made to pay for its wear and tear. A bill that passed the House of Lords late in July provided for a tax of 7.5 mills per mile run by omnibuses over the new Great West road in Middlesex, as a contribution toward the cost of the upkeep of the road. This move may well be noted by communities in this country where to an increasing extent motorbus lines are wearing out city streets without any other recompense than a trifling vehicle tax.

It increases the significance of these happenings to recall that in Great Britain motor licenses are much higher than ours and that it levies a petrol tax of 6 cents a gallon, the income of which goes to the Road Board. The license fees are from £1 for a motorcycle to £50 for heavy, high-power vehicles. The receipts from the petrol tax from May, 1910, to April, 1914, were £4,810,818. From April to September, 1914, the fourth annual report of the Road Board estimates, the receipts will be £2,270,000. It is to increase this income that wheel and mileage taxes and tolls are now being considered. The London "Surveyor," which has long reflected intelligent and well-informed interest in road construction and management, is opposed to a return to the tollgate, but grants that there is to be met "a very critical period in the development of the highway system and of road locomotion." To meet the need for road funds and to obtain them from those who are largely responsible for wearing out roads, the "Surveyor" advocates a general and graduated wheel tax, or axle-weight tax, to apply to all vehicles, but aimed especially at the motorbus, trucks, tractors and lorries. Similar measures have been repeatedly advocated by the Engineering Record, and it is again urged that communities should at once consider taxes in relation to the destructive effect of various vehicles on roads. If this is not promptly done the general public will be obliged to pay out of its pocket millions of dollars that should be paid, in a much larger proportion than at present, by the heavier types of motor vehicles.

The citizen's committee, headed by Dr. Charles S. Howe, president of the Case School of Applied Science, which has recently reported on the paving situation in Cleveland, Ohio, recommended a wheel tax on all vehicles as a means of raising part of the money needed for replacement and repair of streets. Are there other communities that can contribute information as to present or intended moves along the same line? If there are, the Engineering Record would like to hear from them.

The Little River Drainage Improvements

Controlling Flood Waters by Detention Basins Draining Low Ground and Benefiting More Than 500,000 Acres of Alluvial Land in Missouri

THE improvement now under construction within the Little River Drainage District, at an expenditure of about $4,600,000, will afford flood protection and local drainage to a rich alluvial valley about 90 mi. long and 10 mi. wide in the extreme southern portion of Missouri, now under the servitude of flood waters from 1136 sq. mi. of tributary area in the Ozark Mountains, discharging through Castor and Whitewater Rivers, Crooked Creek and other minor streams.

This is accomplished by the control and diversion of headwater streams eastward across the north end of the district to the Mississippi River, a distance of about 30 mi., by a system of impounding basins, with a connecting system of channels supplemented by floodways. The basins are located at the points of diversion of the major streams, receive the flood impulse, and break and reduce its crest by storage. The diversion channels are proportioned to ordinary and freshet flow. Only under flood conditions is the major flow carried by the floodways. The detention basins will be dry except when under flood stress.

The drainage of the valley will be accomplished by the usual method of lateral canals of varying capacity discharging into main canals. The work has been divided into twenty-nine contracts, aggregating about 43,000,000 cu. yd., at a total cost of about $4,000,000. The plants required on the work will consist largely of floating steam dipper dredges for the drainage work and electrically operated dragline machines on the diversion system.

ORGANIZATION

The Little River Drainage District is organized under the Missouri Circuit Court drainage laws and as such is a political subdivision of the State, operating as a corporation for a period of 50 years, with a governing body of five members elected by the landowners.

The cost of the improvement is defrayed by bonds issued with the land embraced within the district as security, the interest and retiring principal being collected with the State and county taxes, the same as are school or other municipal debts.

The apportionment of the cost is made on a unit basis of 1-16 sections, or 40 acres, by a board of three commissioners appointed by the circuit court of the county having the largest acreage within the district having jurisdiction. Each tract pays in proportion to the benefits assessed. In the case of this district the total benefit amounts to $13,700,000, the maximum benefit being $40 per acre and the minimum $4. The average is about $31.50 per acre.

The district has a growing season of seven or eight months between killing frosts, making it possible to raise two crops per season. Drainage will enable it to produce heavy yields of corn, wheat, oats, cotton, hay and other crops.

On similar adjacent lands drainage costing about $8 per acre has increased the value of that land within the last 10 years from $10 per acre to $125 per acre.

GENERAL DESCRIPTION

The district embraces 488,000 acres, being a portion of six counties extending from the Ozark hills, west of Cape Girardeau, to the State line between Missouri and Arkansas. It lies between elevated plateaus of second bottom land. It is a uniform plane with a slope of approximately 1 ft. to the mile to the south. Headwater streams delta soon after entering the valley and their ordinary and flood flows pass through the district as overflow or are stored in the low swales and depressions. Lands adjacent to the district, not subject to the headwater overflow, or capable of being protected by levees, are reclaimed by drainage canals discharging into the Little River Drainage District. About 30 per cent. is permanently under water and 70 per cent. under water from two to six months each year. The depth of overflow varies, averaging perhaps 12 in.

The district is covered by a network of railroads aggregating about 160 sq. mi. It contains several important towns and has a rapidly growing population of about 10,000. About 85 per cent. of the area is covered with a heavy growth of timber, leaving 15 per cent. in cultivation. The soil, in general, is Sharky clay and Waverly loam, varying in depth from 3 to 8 ft., with occasional black sandy ridges.

DIVERSION AREAS—FLOOD VOLUME

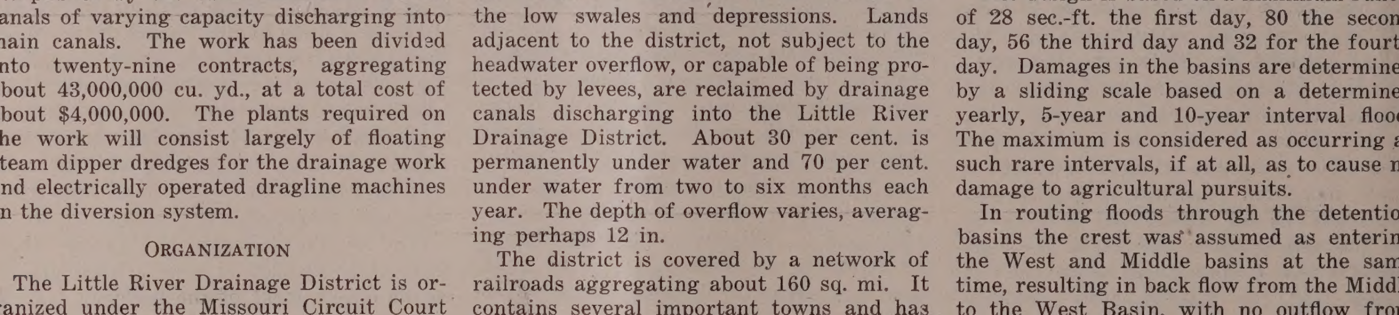
The headwater diversion area is triangular in shape, with its apex about 10 mi. northeast of Fredericktown, Mo., and a base about 30 mi. long extending west from Cape Girardeau, Mo., along the foothills. The topography is rugged. The main valleys, with their tributaries, form a network of minor valleys, ranging in width from 100 ft. to 3000 ft., with steep hills on each side having slopes of 3:1, or perhaps more. The soil as a whole is reddish yellow clay underlaid with hardpan, all comparatively impervious. The ridges are covered with a scrub oak and are also quite thickly covered with flint rock and sandstone. Perhaps 35 per cent. of the area is in cultivation and lies chiefly in the Crooked Creek and Whitewater watersheds. Flood waters passing down the valleys are obstructed by railroad and highway embankments, fences, etc.

Maximum storms passing over the diversion area originate generally in central Texas, with a northeasterly movement. The annual rainfall varies from 42 to 58 in. The greatest recorded rainfall for this area was that of July, 1905, with a precipitation of 6.45 in. on the 20th, followed by a precipitation of 0.91 in. on the 21st. However, storms of from 8.3 in. to 9.5 in. in 48 hr. and from 10.5 to 13 in. in 72 hr. have been recorded at stations in the vicinity of the diversion area.

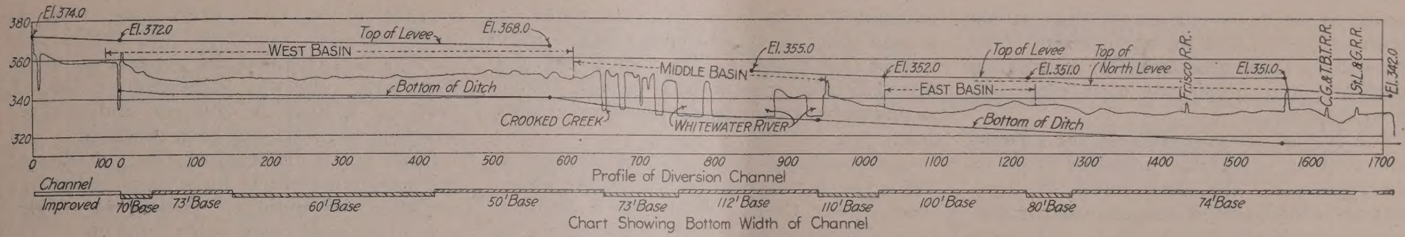
DESIGN

The design is based on a maximum runoff of 28 sec.-ft. the first day, 80 the second day, 56 the third day and 32 for the fourth day. Damages in the basins are determined by a sliding scale based on a determined yearly, 5-year and 10-year interval flood. The maximum is considered as occurring at such rare intervals, if at all, as to cause no damage to agricultural pursuits.

In routing floods through the detention basins the crest was assumed as entering the West and Middle basins at the same time, resulting in back flow from the Middle to the West Basin, with no outflow from the latter until 31 hr. after the storm began. To allow for the movement of crest through the basins the Crooked Creek hydrograph is placed 8 hr. back, to allow for the movement through the West Basin. The outflow is computed from Chezy's formula, using for n numerical values of 0.030 for channel and 0.045 for floodway. The slope is determined by considering a given stage as a contracted channel and treating it as a weir. The discharge so obtained is substituted in modified form of Chezy's formula and solved for slope. The duration curve of the West Basin is typical of the other reservoir curves. The outflow from the Middle to the East Basin was deter-



PLAN OF PROPOSED FLOODWAYS, CHANNELS AND BASINS FOR DIVERSION OF HEADWATERS TO THE MISSISSIPPI



PROFILE OF PROPOSED FLOODWAYS, CHANNELS AND BASINS FOR DIVERSION OF HEADWATERS TO THE MISSISSIPPI

mined by establishing rating curves of a similar nature, using factors of 0.025 and 0.035 for channel and floodway respectively.

The conditions under maximum service, imposed on the design, is the maximum storm discharging simultaneously with a flood in the Mississippi River equal in height to that of 1844, or 12 ft. out of banks. This is the record of the river at point of outfall.

Impounding and Diversion Works

The West Basin begins near where Castor River emerges from the hills and extends eastward about 12 mi. It has an average width of 1¼ mi., an area of 15 sq. mi. and a capacity of 5,000,000,000 cu. ft. at an elevation of 367 ft., which leaves an average freeboard of 3 ft. The basin is formed by the foothills on the north and an earth embankment 12 to 20 ft. high, with 12-ft. crown and side slopes 1:2. The material for this embankment is obtained from the diversion channel located parallel and immediately north of the South Basin wall. The channel section will have a slope of 1:2 on the south side and 3:4 on the north; its minimum berm will be 40 ft.

The peak discharge at the entrance is estimated at about 64,500 sec.-ft. and is reduced to a maximum of 34,000 sec.-ft. at the outlet. In passing through the basin it is retarded about 8 hr. Under ordinary conditions the flow from Castor River will be carried eastward within banks of the diversion channel to the Middle Basin at the entrance of Crooked Creek. To facilitate the movement through the basin at high stages a strip 500 ft. wide will be cleared and maintained as a floodway.

Middle Basin

The Middle Basin is bounded on the north and south sides by the foothills and elevated ridges well above the flood lines. It has an area of 4½ sq. mi. and a maximum capacity of 1,047,320,000 cu. ft. Crooked Creek and Whitewater River channels flowing through this basin have been appropriated for the diversion channel and will be improved to an increase in their present capacity of about 25 per cent. The inflow has an estimated peak discharge of 70,000 sec.-ft. and is reduced to 51,000 sec.-ft. at the outlet. The regulated discharge is passed into the East Basin through a floodway 1600 ft. wide and a diversion channel of 110-ft. base width. The embankment is of sufficient height to give an average freeboard of 3 ft. above the maximum flood line.

The East Basin is formed on the north by the foothills, on the east and south sides by earth embankments from 12 to 20 ft. high, with crowns 8 ft. wide and side slopes 1:3. The diversion channel is immediately north of the south wall and has the general section of the channel in the West Basin. The maximum berm is 40 ft. The basin has an area of 5 sq. mi. The storage considered available is that above the flood plane of the 1844 flood in the Mississippi River and amounts to 418,200,000 cu. ft. The maximum inflow is 51,000 sec.-ft. and is reduced to 46,000 sec.-ft. To facilitate the movement through the basin at high stages a floodway cleared to 1000 ft. will be maintained.

Outlet to Mississippi River

The outflow of 46,000 sec.-ft. from the basin will be carried to the Mississippi River through a floodway 940 ft. wide and a channel having an average base width of 74 ft. The flow will be confined by embankments on the south side of the channel and north side of the floodway. These will have dimensions similar to those of the East Basin, and their average heights will be 16 to 20 ft. The minimum berm will be 40 ft. wide. A channel will be constructed along the north side of the north embankment to take care of the intercepted drainage.

The grade of the north embankment, east of the East Basin, will be 2 ft. lower than that of the south embankment and will serve as a spillway should the stage in the floodway exceed the maximum computed stage; and while this will flood an area of about 2000 acres, it adds materially to the safety of the south embankment, which is the controlling line maintaining the entire system. The diversion channel within the above limits is proportioned to ordinary and freshet flow.

Near the outlet to the Middle Basin, just west of Allenville, a spillway is provided. This will be 1700 ft. long, and operating under a 2-ft. head it will discharge 20,000 sec.-ft.

Embankment Protection and Reservoir Operation

The faces of embankments wherever exposed to direct current attack will be protected by an impervious facing, and in the channel, where the soil requires it, the south slope will be revetted.

The question of silting up the reservoirs by sediment brought down by the streams controlled is not considered serious, as the streams during all but excessive floods run essentially clear, and the detritus carried into the reservoirs at flood periods will not materially affect the capacities of the basins.

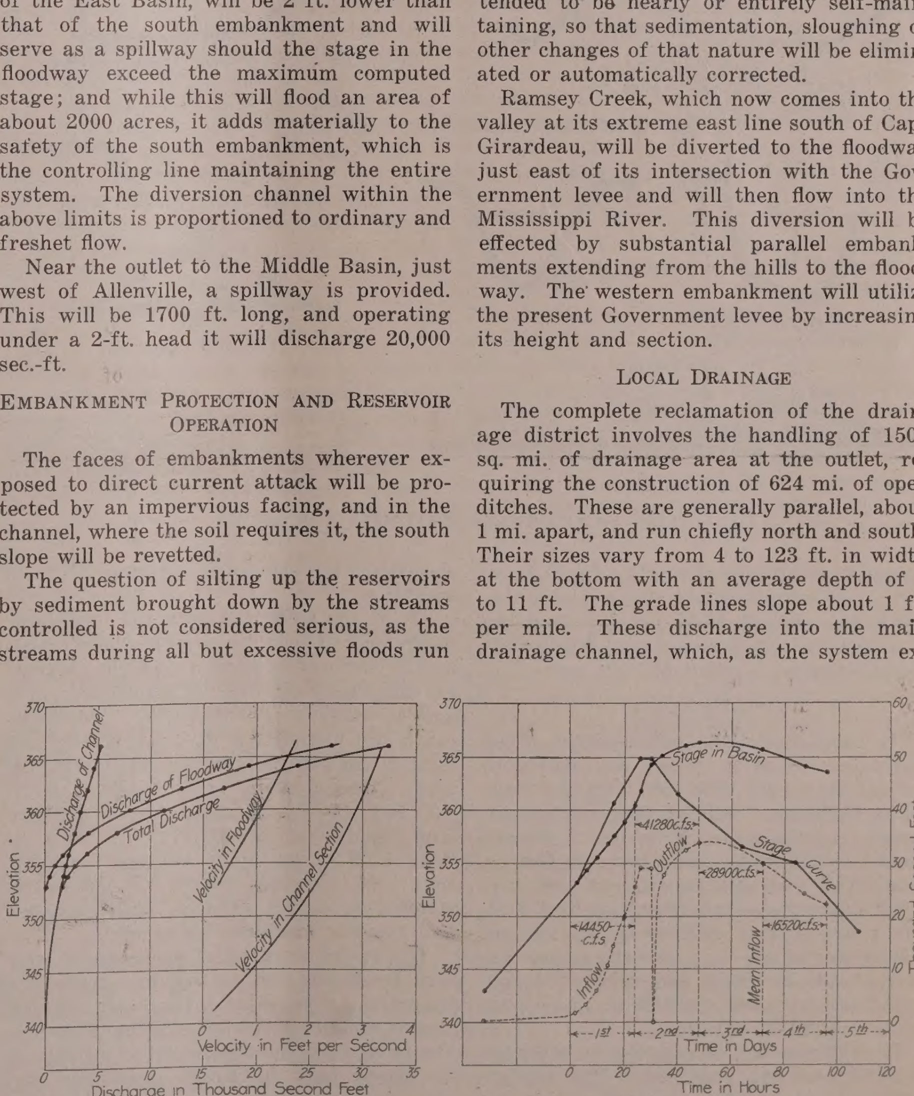
The basins are largely left timbered, presenting less resistance to floods than would be occasioned if the timber was cut and replaced by second growth of brush and briers. Agricultural operations in them will be restricted to such crops as will not cause serious obstruction to flood flow. In the floodway proper no plant life other than grasses for grazing purposes will be permitted.

The construction of the entire system is such that the different flow areas provided will care for the successive stages of flow without the operation of any mechanical device and without changing any features of the channel or arrangement of outlets, thus making it entirely independent of personal operation. It is also intended to be nearly or entirely self-maintaining, so that sedimentation, sloughing or other changes of that nature will be eliminated or automatically corrected.

Ramsey Creek, which now comes into the valley at its extreme east line south of Cape Girardeau, will be diverted to the floodway just east of its intersection with the Government levee and will then flow into the Mississippi River. This diversion will be effected by substantial parallel embankments extending from the hills to the floodway. The western embankment will utilize the present Government levee by increasing its height and section.

Local Drainage

The complete reclamation of the drainage district involves the handling of 1500 sq. mi. of drainage area at the outlet, requiring the construction of 624 mi. of open ditches. These are generally parallel, about 1 mi. apart, and run chiefly north and south. Their sizes vary from 4 to 123 ft. in width at the bottom with an average depth of 8 to 11 ft. The grade lines slope about 1 ft. per mile. These discharge into the main drainage channel, which, as the system ex-

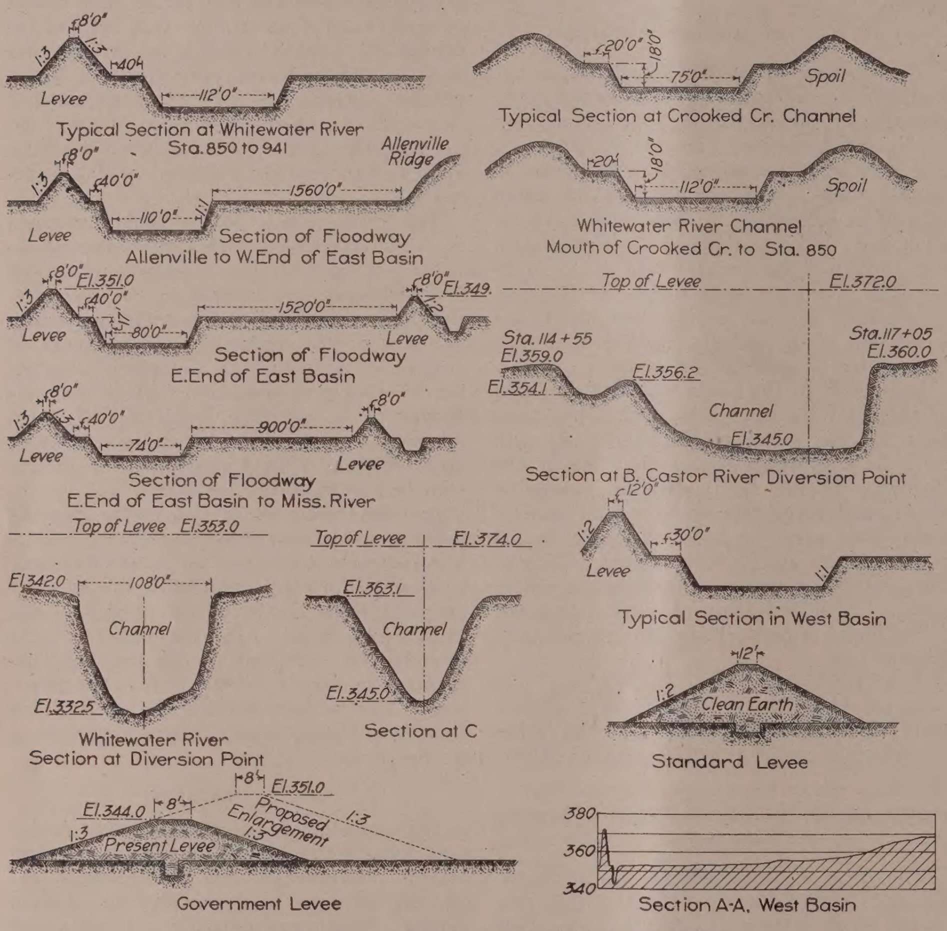


Discharge and velocities of outflow

Inflow, outflow and stage during maximum flood

DIAGRAMS SHOWING HYDRAULIC CONDITIONS AT WEST BASIN pands, is so much increased that at the intersection of Ditch 81, about 60 mi. down the valley, it is necessary for economical construction to divide the main ditch into three channels.

The ditches are proportioned for a runoff computed by a formula prepared from investigations by the Department of Agriculture in the State of Illinois, used in conjunction with results obtained by current-meter measurements on drainage ditches within and adjacent to this locality. The mean annual rainfall of this territory is about 43 in., and 3 in. in 24 hr. is accepted as the economic unit of rainfall for the entire area. The heaviest storm on record for this area gave an average precipitation over the entire district of about 11.4 in. in three days. The estimated cost of the local drainage work is about $6.67 per acre and the total cost of local drainage and headwater-flood protection is about $10 per acre.



SECTIONS OF FLOODWAYS, CHANNELS AND LEVEES.

Construction

The location and general character of the headwater diversion works are shown in the accompanying plan and cross-sections. All embankments will be thoroughly compacted and must be built on a surface plowed or otherwise broken up to form a bond. The muck ditches required will have a 6-ft. base and a minimum depth of 8 ft. The type of levee revetment has not yet been determined, but investigations are being made on plain and reinforced concrete, anchored and monolithic, in sections from 15 to 20 ft. square.

The spillway will be constructed after the embankment has seasoned. The surface will be dressed to the required outline and faced on both sides with concrete. It will be provided with a banquette, located approximately 6 ft. below the crest, which will extend about 40 ft. and have a fall of about 1 ft. in that distance. The ends of the spillway will have cross-walls to protect the adjacent embankment from the action of overflow.

Caney settling basin, having an area of 400 acres, is provided to receive the waters from Caney Creek, which has a drainage area of about 20 sq. mi. This stream carries a very large amount of sediment, which will be deposited in the basin, while the water will be drawn off into the main ditch through a concrete tunnel. It is assumed that the basin has a capacity sufficient to remain operative for at least 10 years before the sediment deposited will reach an elevation high enough to interfere with its operation.

All of the work for both the headwater diversion and local drainage has been classified to conform to certain types of excavating machinery and to contain sufficient yardage to make them attractive. This warrants the installation of large plants, and most of the contracts have a 30-month time limit. Minor work is all adapted to 1-yd. and 1½-yd. floating dipper dredges. The headwater diversion work will be done with larger units, varying from 2½ to 4½-yd. capacity, which will not be restricted to dipper dredges, both clamshell and dragline machines being used.

The entire working of spoil can be handled to destination at the first excavation operation, provided its character is such that it remains stable after being deposited. Owing to the consistency of the material it is feared that additional provisions may have to be made on account of a tendency to flow in fresh banks.

The organization of the district was accomplished by Otto Kochtitzky, who, as chief engineer, conducted the preliminary surveys and outlined the general plans for the work. He was succeeded on Dec. 1, 1910, by William A. O'Brien, under whose direction the work has been continued.

Parts of the diversion system and some of the smaller contracts have been under way for about 12 months. Orders for beginning of all work were given June 20.

The plans have been approved by Isham Randolph, Chicago, Ill., the district's consulting engineer; Prof. Daniel W. Mead, Madison, Wis.; J. A. Ockerson, St. Louis, Mo., and Arthur E. Morgan, Memphis, Tenn.

San Francisco's Water-Supply Policy

City Engineer M. M. O'Shaughnessy Speaks of Spring Valley Suit and Hetch Hetchy Project at Meeting of Engineers' Club

SAN FRANCISCO'S water-supply policy, with particular reference to the acquisition of the plant of the Spring Valley Water Company and the construction of the Hetch Hetchy works, was outlined by M. M. O'Shaughnessy, city engineer, in an address delivered Aug. 5 at a luncheon of the Engineers' Club at the Hotel Sutter, San Francisco. With the exception of Denver, Mr. O'Shaughnessy said, San Francisco is the only large city in the United States which does not own its water supply.

Since the new charter of 1900, when water rates were reduced, the Spring Valley Water Company has made very little extension to its system. In fact, it has ceased laying large distributing pipes through the city, and the pipes now laid in the outlying district are less than 2 in. in diameter. In some portions of the city, due to lack of water pipes, the condition of the people is very serious. In the Richmond section a population of 40,000 is fed by one 16-in. pipe. There are miles and miles of asphalt streets in that section with property worth hundreds of dollars per front foot dependent on one water-service pipe.

Spring Valley Negotiations

In Washington last year, when the city's representatives were appealing to the National Government to give the city the Hetch Hetchy grant for a future source of supply, assurances were given Congress by the city officers that San Francisco proposed to acquire the Spring Valley Water System. In pursuance of this policy, condemnation suit was filed against that company last December to acquire all of its property that was necessary and useful in connection with a future Sierra supply. With that end in view, and during the six months of last year, Mr. O'Shaughnessy compiled a report delineating all the properties that were necessary for a municipal supply, and that included about 1000 acres of land in the city and county and about 67,000 acres outside of the city. The attorneys for the city were able to get the attorneys for the Spring Valley water system to agree to accept $34,500,000 for all the properties described in this condemnation suit. This is about $3,000,000 less than the price last demanded by the company. The company then asked $37,500,000 about eighteen months ago, and the city offered $37,000,000.

At the present time the water system is developed up to 40,000,000 gal. per day. About 20,000,000 gal. are taken from the peninsula system of San Francisco, comprising the three reservoirs of Crystal Springs, San Andreas and Pilarcitos, with a combined capacity of 30,000,000 gal. The Crystal Springs reservoir capacity can be nearly doubled at a moderate expense by raising the dam about 50 ft. in height. The capacities of Alameda, Pleasonton, Calaveras and San Antonio sources are now 20,000,000 gal. daily.

NEW DAM

The company has under construction a dam of the hydraulic-fill type at Calaveras, intended to be 200 ft. high. The city practically assured the company a return on this item of outlay provided the company went ahead and built this dam. About a year ago last August the Spring Valley Company started and made good progress until about January or February of this year. Since that time it has been proceeding slowly, due perhaps to the condemnation suit, but if the proposed purchase is agreed upon it is likely that the Spring Valley company will begin active construction operations. Naturally, the company is a very timid corporation—very susceptible to external influences, according to Mr. O'Shaughnessy. With the completion of the Calaveras dam, that reservoir with a capacity about equal to the combined capacity of all the three peninsula reservoirs, nearly 30,000,000 gal., will add to the present supply about 20,000,000 gal. a day more, so that with a comparatively moderate expense at least 25,000,000 gal. per day can be taken out of the undeveloped portions of the Spring Valley.

FINANCES

The total revenue of the Spring Valley Company for 1912-13 was $3,292,000; operating expenses, $840,775; taxes, $116,000 —making a total of $1,221,000, which makes a net revenue of $2,071,000 to meet interest on bonds, stock dividends and depreciation. At $34,500,000, the proposed purchase price, on a basis of 4½ per cent the interest charge would be $1,552,000 yearly, and deducting that from the net of $2,071,000 would leave $518,000 for a profit, including the depreciation. The depreciation may safely be estimated to be from $250,000 to $300,000 a year on a plant of this magnitude, so that even at the present prices from the present figures and under city administration Mr. O'Shaughnessy believes a very small profit can be made at the present sale price. He estimates about $218,000 a year.

The entire distributing system of Spring Valley inside the city is about 568 mi., of which 424 mi., or 74 per cent, is cast-iron pipe which has been in for 22 years, 11 per cent is wrought-iron riveted pipe which has been in for 27 years, and 133 mi. is small pipe with an average age of 10 years, which confirms the statement that the policy of the Spring Valley Company for the last 10 years has been to put in very small pipes so as to get the commodity to the consumer at a minimum of expense and defer capital expenditure for larger pipe. Of course, this situation would be changed under city ownership, as the city would put in pipes of a larger diameter—none less than 6 or 8 in.—and map out a more generous policy toward consumers.

The city has the alternative of either buying Spring Valley or ceasing all negotiations and going ahead at once with the complete construction of the Hetch Hetchy system. All estimates, including Mr. Freeman's, figure about $40,000,000 to the city boundary line and with the necessary distributing reservoirs, land, pipe lines and pumping stations inside the city, will cost $12,000,000, or $14,000,000 more, so that it will make $54,000,000 or $55,000,000 for the water supply and its delivery to the consumers in the city, exclusive of interest during construction.

Now, what will happen when this alternative is adopted? The city will have to pay interest on the entire $55,000,000 until the first day it delivers water. Eighty thousand taps now exist and the change from the private to the public company will be slow and prolonged and there will be a tremendous economic waste during the transition.

The policy of the city administration is, however, a broad one, and it is endeavoring to tackle this question as a business question and solve it on its business merits and treasure no resentments on account of past controversies. The idea is to acquire the company for about $34,500,000, spending about $8,000,000 on the completion of the Calaveras dam and advancing construction toward the Hetch Hetchy system, reducing its total cost and gradually developing the present system to its limit. Forty million gallons are to 65,000,000 gal. as $3,200,000 is to $5,200,000, so that the purchase of this system on this plan and its progressive development, using receipts from sales of water, will make no burden on the taxpayers of San Francisco. In the meantime the city will proceed to develop the mountain-water supply, build the Hetch Hetchy dam, 20 mi. of aqueduct and develop 30,000 hp. as a first unit of hydroelectric power which will help to operate the municipal railways in San Francisco. The whole purpose of this policy is to keep the tax rate down and help acquire other public utilities and proceed in a sound and reasonable manner with the financial policy of the city.

Preventing Pavement Cuts

CUTS in pavements in the city of Westminster, England, are reduced to a minimum by a method which is commented upon by George W. Tillson, consulting engineer of the Borough of Brooklyn, New York City, in his recent report on investigations of pavements in European cities. Wherever possible, Mr. Tillson says, subways, telephone and electric-light lines are laid in the sidewalk area, so that the roadway will not be disturbed during construction or repairs. The most striking practice of reducing the number of street openings is the ruling that no sewer shall be smaller than 2 ft. 4 in. x 3 ft. 6 in. Workmen, therefore, can enter the sewer and tunnel from it into the house line for a connection, and in this way the surface of the street is not disturbed. This practice, Mr. Tillson points out, is particularly interesting from the fact that in America most cities will not permit tunneling except under special conditions.

A MUNICIPAL "MOVIE" THEATER, according to the San Francisco "Municipal Record," pays all the expenses of the Haven (Kan.) water plant, as well as a large share of the other municipal expenses. The town, which has a population of less than a thousand, built the theater, but as it could not legally manage it a commercial club was formed for that purpose.

Rulings on Road Building in New Jersey

Bids May Be Asked on Any One Patented Pavement and Specifications May Not Refer to Several Different Types of Construction

By LE ROY W. ALLISON

LEGAL decisions affecting New Jersey practice in requesting bids on patented pavements and in preparing specifications for general road building were handed down July 2 by State Attorney-General John W. Westcott.

The first finding holds that there is no legal prohibition against requesting bids upon a single type of patented pavement by a county or municipality. In so advising Col. Edwin A. Stevens, State road commissioner, the attorney-general asserts that there must be evidenced such conditions as to render competitive bidding possible, that the competition must be bona fide, and that more than one bidder must appear before a contract is awarded. The elements of competition must be shown by the possibility afforded to all who desire to bid upon the particular work to know the price at which the material in question may be purchased by all prospective bidders alike.

PREPARATION OF SPECIFICATIONS

In defining the preparation of general specifications the rulings state that the attention of bidders must be directed to a single definite proposition, upon which they should be required to submit proposals. The contract must be awarded to the lowest responsible bidder upon the stipulated proposition. It is not intended that it is necessary to call for a particular type or kind of pavement by name, but specifications should call for a pavement to be constructed of specific materials, and to be built in the manner and with the methods specified.

To illustrate, it would be improper to call for concrete, macadam, telford or other distinct foundation, the bidder to be at liberty to bid on any or all. The road department and the county authorities should select the kind and type of foundations and wearing surface to be used before bids are invited by advertisements, and the specifications upon which bidders estimate should describe and call for these kinds and types.

It is not to be inferred that the specifications must not allow any variance in the materials to be used—for instance, specifying a particular kind of asphalt or bitumen preparation—but they must describe and call for the type and kind of road decided upon, and the specifications must be approved before the bids are advertised.

GROSS OPERATING REVENUES for May on the large railroads of the United States, according to a bulletin issued by the Interstate Commerce Commission, were $1,029.70, as compared with $1,149.75 for May, 1913, and $1,030 for May, 1912. Operating expenses were $779.38, as compared with $829.94 and $734.97 for the corresponding months in 1913 and 1912. Hence the net operating revenues were $250.32, $319.81 and $295.03 for May, 1914, May, 1913, and May, 1912, respectively. The operating ratios of 71.36 and 72.19 for May, 1912, and May, 1913, increased to 75.69 for May, 1914.

Water-Discharge Measurement with Chemicals

Titration Method Described by B. F. Groat, Hydraulic Engineer, of Pittsburgh, Before Engineers' Society of Western Pennsylvania—Part I

CHEMICAL gaging of discharges of water is rapidly being recognized as one of the most accurate methods available for that purpose. The most recent exposition of the subject is a paper, reprinted below, by B. F. Groat, hydraulic engineer, of Pittsburgh, which was presented recently before the Engineers' Society of Western Pennsylvania and appears in the May "Proceedings" of that organization.

Perhaps the most difficult discharge to measure is that of a turbulent mountain stream. Let us suppose, therefore, that we select the upstream or dosing station above a cataract or rapid, where the thorough mixture of the chemical will be effected. If the concentration of the chemical solution employed be C grams per liter of water and the solution be introduced at the dosing station at the rate of q liters per second, while the chemical analyses of samples of water taken above the dosing station, and at the sampling station below the rapid, give concentrations of c_1 and c_2 respectively, then it is clear that the discharge of the mountain torrent must be

$$Q = [(C - c_2)/(c_2 - c_1)]q \qquad (1)$$

This equation results simply from the consideration that the total quantity of chemical passing the dosing station must equal that passing the sampling station below. Thus $Qc_1 + qC = (Q + q)c_2$.

If we wish to be very particular, as in the case of measuring the discharge of a turbine, and if the dosing station be above while the sampling station be below the point at which the discharge is to be ascertained we easily deduce

$$Q + q = [(C - c_1)/(c_2 - c_1)]q \qquad (2)$$

If the water be initially free from the chemical which is introduced at the dosing station, the analysis would show that $c_1 = 0$. Hence the discharge would be given by

$$Q = [(C/c_2) - 1]q, \ c_1 = 0 \qquad (3)$$

But if the discharge at the sampling station is required and there be none of the chemical initially present, the formula would become

$$Q + q = (C/c_2)q, \ c_1 = 0 \qquad (4)$$

In order to have a satisfactory analysis, there must be sufficient of the reagent present to give the required degree of precision. Thus, if the measurement is to give the discharge with a permissible error of about 1 per cent, and the balance employed in the gravimetric analysis will turn for 0.1 part of a milligram, then the sample taken at the sampling station should contain at least 10 milligrams of the chemical introduced at the dosing station—that is, at least 10 milligrams more than the stream contains initially. It is, therefore, necessary to determine the quantity of solution to be introduced at the dosing station. The rate of dosing in liters per second is given by

$$q = [(c_2 - c_1)/(C - c_2)]Q \qquad (5)$$

If we know in advance the approximate discharge and from a preliminary analysis the value of c_1, then the necessary concentration, c_2, determines the value of q in equation (5). The concentration C is arbitrary up to the point of saturation.

Suppose, for example, that it is desired to determine the rate of dosing when the approximate discharge is 50 cu. m per second, that is, 50,000 liters per second, and the dose is a saturated solution of sodium chloride, containing 312 grams of salt per liter. Then, if the water contains no salt initially and it is desired to have 1 milligram of salt in each liter of sample we shall have $c_2 = 0.001$, $c_1 = 0$, $C = 312$ and $Q = 50{,}000$, or

$$q = [(0.001 - 0)/311.999]50{,}000 = 0.16$$

liters per second by equation (5).

If, however, the sample is treated with a precipitating reagent, the equivalent weight of the precipitate must be introduced in the equation. Let p be the equivalent weight of the precipitate per gram of the dosing chemical. Then formula 5 becomes

$$q = \frac{r - c_1}{C - r} Q = \frac{P - c_1 p}{Cp - P} Q \qquad (6)$$

Here r is the ratio of the weight; P of the precipitate per liter of sample to the equivalent weight; p of precipitate per gram of dosing chemical. If $c_1 = 0$, the equation may be put in the form

$$q = \frac{1}{(C/r) - 1} Q$$

$$= \frac{1}{(Cp/P) - 1} Q, \ c_1 - 0. \qquad (7)$$

These equations, consequently, take the same form as equation (5) when the equivalent weights of the participating reagent are employed in place of the weights, c_1, c_2 and C, of the dosing chemical, as might have been anticipated.

Suppose it be required to determine the rate of dosing and the total amount of salt for a test of an hour's duration in the case of the stream above, where the discharge is known to be approximately 50 cu. m per second and the sample is to be treated with silver nitrate, a common reagent for this purpose. Let it further be required that the samples should contain 1 milligram of precipitate per liter. This precipitate will be silver chloride. In order to determine the equivalent weight, p of silver chloride per gram of sodium chloride it is necessary only to observe that a molecule of salt, NaCl, precipitates a molecule of silver chloride, AgCl. The atomic weights of the elements involved are: Na = 23.0 (sodium); Cl = 35.5 (chlorine); Ag = 107.9 (silver).

Therefore

$$p = \frac{\text{mol. wt. of AgCl}}{\text{mol. wt. of NaCl}}$$

$$= \frac{107.9 + 35.5}{23.0 + 35.5} = 2.45.$$

Therefore

$$r = P/p = 0.001/2.45 = 0.000408, \text{ and}$$

$$q = \{1/(765{,}000 - 1)\}Q = 50{,}000/764{,}999$$

$$= 0.0655 \text{ liters per second.}$$

There are 3600 sec. in 1 hr. Hence the total number of liters of dosing solution required for the test is 3600 × 0.0655 = 236, and since each liter contains 312 grams of salt there will be required a total of 236 × 312 = 73,700 grams, or 73.7 kilos of salt. These results are obtained with the aid of equation (7), which, in many cases, gives practically the same rate as equation (6). If it is desired to have the samples contain 10 milligrams instead of 1 milligram it is clear that about ten times as much chemical will be required, etc.

There are many other chemicals and reagents which may be employed for chemical gaging, some of which are specifically mentioned in the paper by Stromeyer on "Gaging Streams by Chemical Means" ("Proceedings" of the Institution of Civil Engineers, Vol. 160).

A milligram of precipitate per liter of water is very little. When the solution is very dilute resort may be had to evaporation when it is impracticable to increase the rate of dosing above a certain amount. The rate of dosing, of course, should be as high as possible. So far as the chemical test is concerned, however, evaporation has the same effect as increasing the rate of dosing.

The volumetric method appears to be more expeditious and better adapted to the convenience of the engineer. The general principle of this method is that if a known volume of sample requires a certain volume of standard solution containing a given weight of reagent per unit volume in order completely to reduce the dosing chemical in the sample, then the concentration of the dosing chemical in the sample can be calculated. The end of the reaction is sometimes ascertained by noticing a characteristic change in color or by having an indicator present. For example, if common salt be precipitated with silver nitrate, the indicator may be of chromate of potassium. While the reaction proceeds a white precipitate of silver chloride continues to form, but the least excess of silver nitrate reacts upon the potassium chromate to form a very intense brick-red precipitate of silver chromate. The end of the reaction may thus be determined with nicety.

In addition to the notation already adopted let c_s = the concentration of the reagent in the standard solution in grams per cubic centimeter; v, volume in cubic centimeters of the standard solution required to reduce the sample volume; V, sample volume, or the volume in cubic centimeters of the sample treated with the standard solution, and C, equivalent of the dosing chemical per gram of the chemical in the standard solution; i.e., the ratio of the molecular weight of the dosing chemical to the molecular weight of the chemical in the standard solution.

In the formulas the subscripts $_1$, $_2$, $_s$ will be employed as relating to corresponding quantities with like subscripts.

With this notation, therefore, it is easy to show that

$$c_2 = v_2 c_s e/V_2 \qquad (8)$$

$$c_1 = v_1 c_s e/V_1 \qquad (9)$$

and consequently

$$Q = \frac{c - (v_2 c_s e/V_2)}{(v_2 c_s e/V_2) - v_1 c_s e/V_1} q \qquad (10)$$

If all samples are rigidly limited to the unit volume, or if the reactions are reduced by calculation to unit volume, then $V_1 = V_2 = 1$, and the following formulæ result:

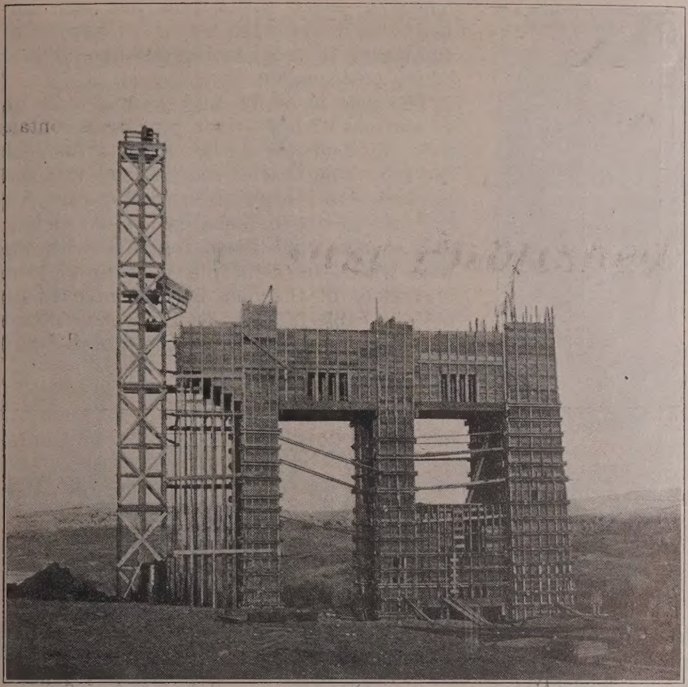
$$Q = \frac{(C/c_s e) - v_2}{v_2 - v_1} q, \ V_1 = V_2 = 1 \qquad (11)$$

$$Q + q = \frac{(C/c_s e) - v_1}{v_2 - v_1} q, \ V_1 = V_2 = 1 \qquad (12)$$

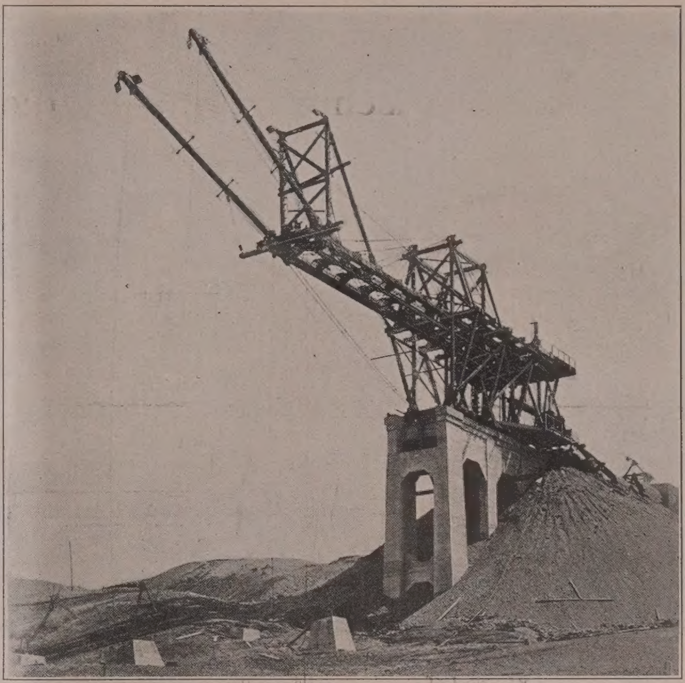
$$Q = [(C/v_2 c_s e) - 1]q, \ c_1 = 0 \qquad (13)$$

$$Q + q = (C/v_2 c_s e)q, \ c_1 = 0 \qquad (14)$$

If the standard solution is silver nitrate, $AgNO_3$, and the dosing chemical sodium



FORMS AND TOWER FOR CONCRETING WEST ABUTMENT



EAST ABUTMENT, PEDESTALS AND ERECTION TRAVELER

chloride, NaCl, we shall have for the atomic weights, in addition to those already employed, oxygen = O = 16 and nitrogen = N = 14.01. The ratio of the molecular weights is then

$$e=\frac{\mathrm{NaCl}}{\mathrm{AgNO_3}}=\frac{23.0+35.46}{107.88+14.01+48.00}=\frac{58.46}{169.89}=0.344.$$

Within the reciprocal of this ratio it is easy to calculate a degree of concentration for the standard solution which will greatly facilitate the determination of the concentrations in the various samples by titration. In the case of the chemicals mentioned above the reciprocal is:

$$\left.\begin{array}{l}\text{Equivalent of the standard}\\ \text{chemical per gram of dos-}\\ \text{ing chemical}\end{array}\right\}=\frac{1}{c}=2.91.$$

Thus, in the case of silver nitrate and salt, if each liter of standard contain 2.91 grams (or milligrams) of nitrate, then for each liter of standard consumed in titration up to the end reaction there will be 1 gram (or 1 milligram) of salt present in the sample. It is merely necessary then to note the number of cubic centimeters of standard consumed in the titration and treat this number as expressing, in thousandths of the unit chosen, the weight of the dosing chemical contained in the sample. In other words, the concentration of the standard solution may be adjusted.

(To be concluded)

Skeleton Abutments for Railroad Viaducts

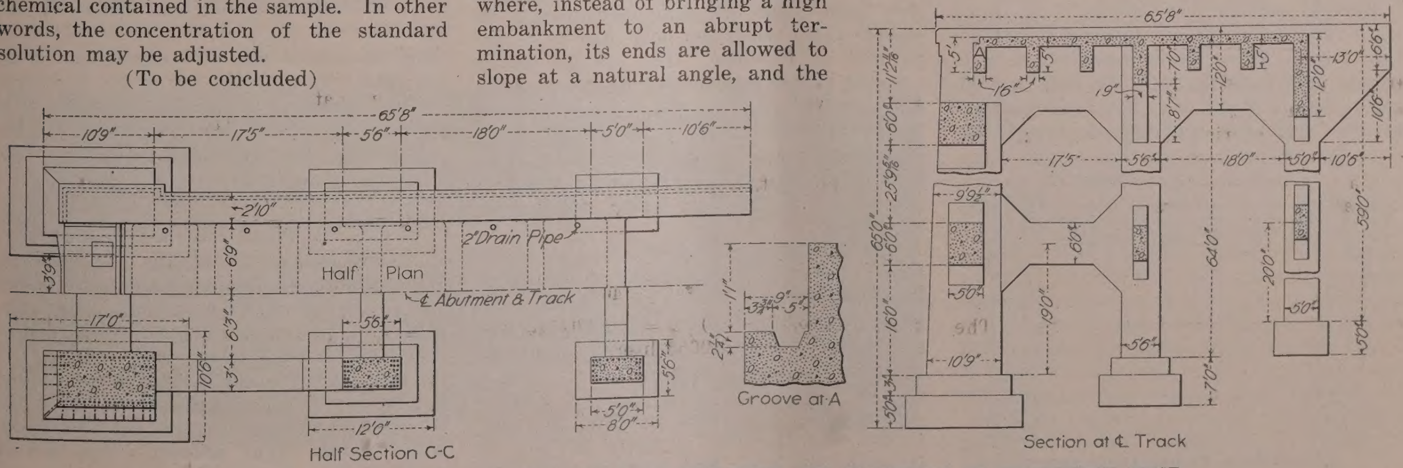
Reinforced-Concrete Column, Girder and Slab Construction to Carry Track Over End Slopes of High Fills to Steel Superstructure

THE abutments of the Judith River viaduct in Montana, on the Lewiston-Great Falls Line of the Chicago, Milwaukee & St. Paul Railway, illustrate advanced practice in the development of reinforced-concrete work which has resulted in the adoption of improved standard designs for substructures. These abutments are examples of a skeleton type of construction in which massive gravity retaining walls are replaced by reinforced-concrete columns, girders and floor slabs, carrying the track over the end slopes of high embankments, and thus preventing the development of, and costly provision for, heavy horizontal earth pressures.

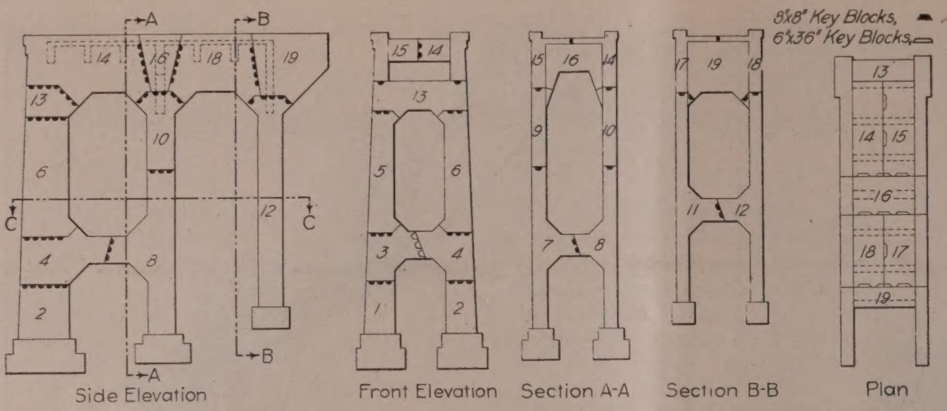
In some cases on this railway viaducts having moderate height and length of span are made entirely of reinforced concrete with solid floor slabs supported directly on transverse bents without the intervention of longitudinal girders. In other cases reinforced-concrete longitudinal girders receive the slabs, and in several instances where the viaducts are of considerable height ordinary steel towers and plate girders are used, except at the ends of the viaduct, where, instead of bringing a high embankment to an abrupt termination, its ends are allowed to slope at a natural angle, and the track over them is supported by reinforced-concrete shafts or piers, between which the fill can freely assume the natural slope, as in this case. This construction has been found more economical and satisfactory than the building of very heavy retaining walls to resist the great lateral pressure developed in high fills. An equally valuable feature is that this type of abutment can be built in the midst of a timber trestle with very little interference with the timber work, thus greatly facilitating renewals, replacing temporary structures with permanent ones and eliminating maintenance charges and fire risk.

GENERAL DESCRIPTION

The superstructure of the Judith River viaduct, about 1954 ft. long between abutments and 135 ft. high above the lowest pedestals, consists chiefly of 46-ft. 6-in. steel towers and 69-ft. 9-in. connecting plate-girder spans. Somewhat longer girders at the ends of the bridge rest on abutments built in fills 57 and 67 ft. high. The east abutment, here illustrated, has three



PART FLOOR PLAN AND SECTIONAL PLAN OF ABUTMENT AND ELEVATION OF TRANSVERSE BENT



DIAGRAMS OF PRINCIPAL ELEVATIONS, SHOWING CONSTRUCTION JOINTS

vertical transverse bents, each consisting of a pair of reinforced-concrete columns with deep transverse struts and kneebraces cast integral with them. The two tallest bents are also connected by longitudinal struts and kneebraces, and the tops of all the columns are connected by longitudinal girders which cantilever beyond the bents at the shore ends, and are kneebraced to the columns.

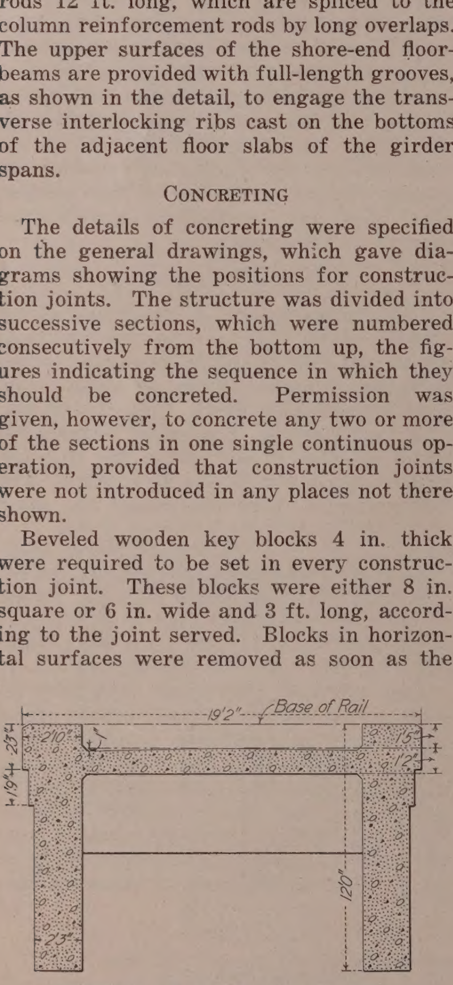
The girders, the transverse floorbeams and the floor slab are proportioned for an E-60 live load. The main reinforcement consists of deformed bars with a net sectional area of 1 sq. in., ½-in. column hoops, and girder stirrups.

The 14-in. floor slabs, cast integral with the beams and girders, are reinforced by ¾-in. rods in the lower part, which are bent upward to resist negative stresses in the slabs over the floorbeams. The columns are anchored to their footings by vertical dowel rods 12 ft. long, which are spliced to the column reinforcement rods by long overlaps. The upper surfaces of the shore-end floorbeams are provided with full-length grooves, as shown in the detail, to engage the transverse interlocking ribs cast on the bottoms of the adjacent floor slabs of the girder spans.

CONCRETING

The details of concreting were specified on the general drawings, which gave diagrams showing the positions for construction joints. The structure was divided into successive sections, which were numbered consecutively from the bottom up, the figures indicating the sequence in which they should be concreted. Permission was given, however, to concrete any two or more of the sections in one single continuous operation, provided that construction joints were not introduced in any places not there shown.

Beveled wooden key blocks 4 in. thick were required to be set in every construction joint. These blocks were either 8 in. square or 6 in. wide and 3 ft. long, according to the joint served. Blocks in horizontal surfaces were removed as soon as the concrete was sufficiently set and in vertical surfaces they were removed with the bulkheads. This abutment contains 56 tons of reinforcement and 750 yd. of concrete, which required 12,500 sq. ft. of form surface.



SECTION OF FLOOR AND GIRDERS

The west abutment is similar to the east abutment, except that the legs are shorter to accommodate the higher elevation of its foundations. The concreting was done in sections defined by the construction joints, and it was endeavored to have each section contain about 25 cu. yd., so that two or three sections could be readily combined. In some cases it was necessary to include considerably more yardage so as to get the joints at convenient places. This abutment contains 31 tons of reinforcement and 507 yd. of concrete, which required 9600 sq. ft. of form surface.

The bridge was designed and the substructure constructed by the engineering department of the railway company, of which C. F. Loweth is chief engineer and J. H. Prior engineer of design.

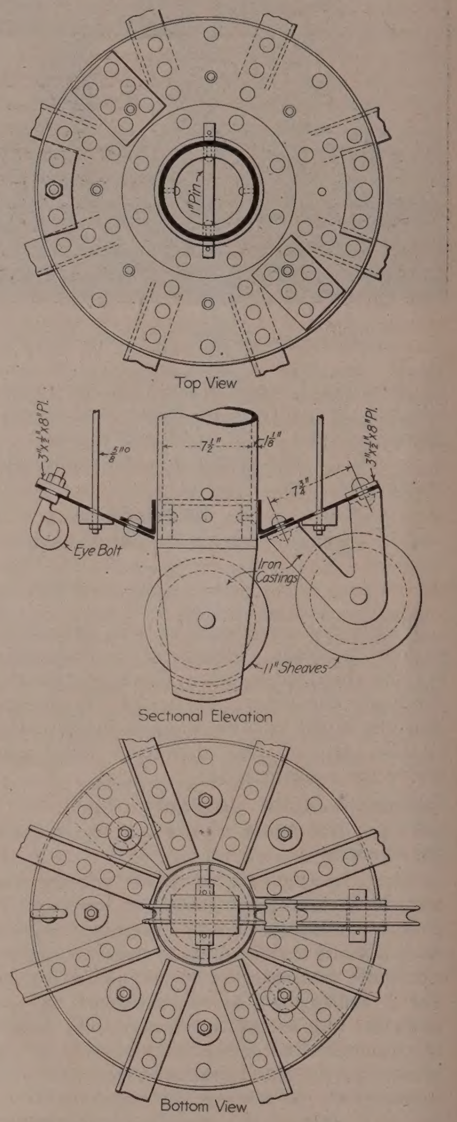
Flagpole Mounting that Lowers Pole for Repairs

Forty-Foot Mast on Hotel Vancouver Is Made Up of Sections of Heavy Cast-Iron Pipe from Eight to Five Inches in Diameter

IN designing the Hotel Vancouver, described in the Engineering Record of April 25, 1914, page 469, it was desired to surmount the fire-escape towers with flagpoles, to carry out the general scheme of architectural treatment. These towers have a hollow core, and it was decided to devise some means for mounting the poles so that they could be lowered directly into this core, thus avoiding dependence on steeple jacks when the poles had to be repainted or repaired. The scheme finally adopted to accomplish this does not introduce any stresses in the support greater than those existing when the pole is in normal position, and it has the advantage of permitting a gradual raising of the pole so that all parts of its length are readily accessible.

The accompanying illustrations show the lower of two "spiders' nests" of structural steel which support the base of the pole. Eight 3 x 3-in. angles anchored to the tower walls support a 5/16-in. circular plate shaped like the frustum of a cone, which carries the base of the pole. A similar conical plate in an erect position, fastened to the roof framing, supports the pole as it leaves the roof, and between these two opposing cones ⅝-in. rods are run vertically and arranged so as to permit of tightening in order to increase the rigidity of the pole support.

The pole is 40 ft. high and is built up of sections of heavy iron pipe graded from 8 in. in diameter at the base to 5 in. at the top. The base of the pole fits over and is riveted to a heavy iron casting carrying one of the 11-in. sheaves. This casting and sheave move down together with the pole when the 1-in. pin is removed, the movement of the pole being controlled by a ½-in. cable fastened to the eyebolt shown and running thence over the movable and fixed sheaves down to a convenient point for fastening near the top of the stairway.



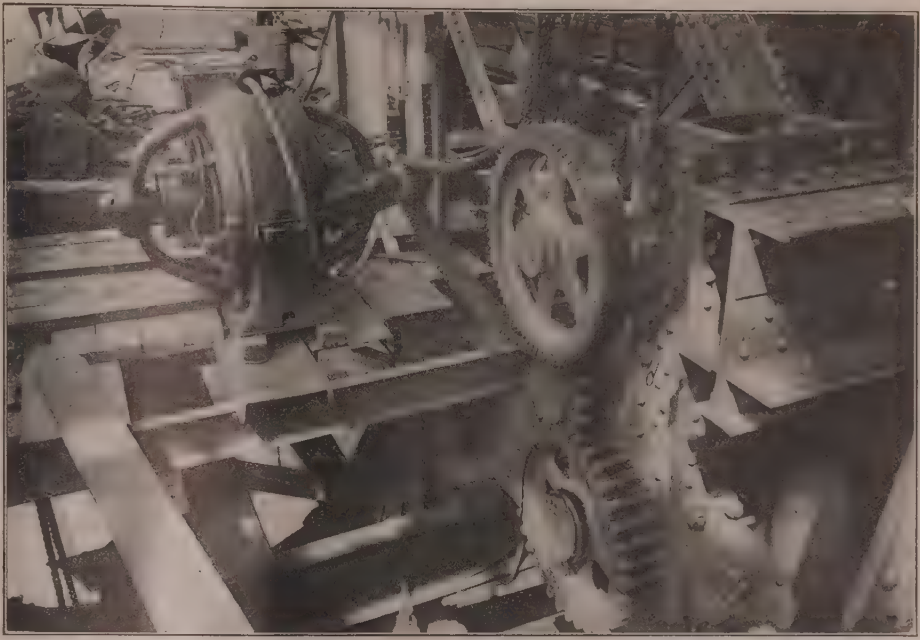
DETAILS OF FLAGPOLE MOUNTING

The device was designed under the supervision of Francis S. Swales, architect of the new Hotel Vancouver.

THE NEW THAMES TUNNEL for carrying the mains of the Metropolitan Water Board of London, England, between Twickenham and Richmond is nearing completion. The tunnel is shield-driven and is lined with cast-iron segments. It is 618 ft. long between shafts, 60 ft. deep, and has an outside diameter of 16 ft. The tube will accommodate five 36 and 30-in. water mains. The present supply mains are laid in the bed of the river.

Bridge Pin-Boring Machine

Chain-Driven Electric-Power Field Tool for Enlarging 10-Inch Hole, Removing about 23 Cubic Inches of Metal per Minute



MACHINE ENLARGING MAIN-CHORD PINHOLES OF WILLIAMSBURG BRIDGE

FOUR main-chord pinholes 28 in. long, in the Williamsburg Bridge, were enlarged from a diameter of 10 in. to 13 in. in less than 1 hr. each by a special high-speed electric tool operated by a chain drive. The construction of the tool, operation of feed and cutters and method of mounting it for service are here illustrated and described. The enlargement of the holes, as described in the Engineering Record of July 4, page 13, was accomplished without disconnecting the members affected and without supporting the span on falsework while the vital pin was removed. The tool was designed by O. E. Hovey, consulting engineer for the Snare & Triest Company of New York, who executed the work under the direction of the engineers of the Department of Bridges.

The machine has a 6¾-in. boring bar, about 7 ft. long, with a full-length groove containing the feed screw, which traverses the cutter head from end to end of the bar at the rate of 1/32 in. per revolution of the bar. The cutter head is about 6 in. long and 12½ in. in diameter. The epicyclic train of feed gears, attached to the front end of the boring bar, is worked automatically when the boring bar revolves and can be cut out to allow the operation of a hand gear, feeding ¼ in. per revolution for withdrawing the cutter head. The latter contains six cutting tools and one finishing tool made of Ultra-Capital high-speed tool steel, each cutting a strip ¼ in. wide. The tools are set in series each 1/16 in. in advance of the next one, and are so arranged that if one should break the next following would take up its load. This provides for a total cut of 1½ in. on each side of the center, thus enlarging the hole from 10 to 13 in. in diameter in one operation at a cutting speed of between 40 and 50 ft. a minute, equivalent to an advance of about 13/32 in. per minute parallel to the axis of the hole.

A study was made of existing high-speed tools and tool steel, and this tool was designed to bore the hole in the specified time of 1 hr. in order to reduce to the utmost the time when the truss members were disconnected at this point and might be subject to displacement. One of the difficulties encountered in the design was the removal of about 1300 cu. in. of steel in chips, which had to be discharged through the 1½ in. annular space between the boring bar and the original pinhole. This was accomplished by shaping the cutting edges of the tools so that the chips produced were automatically curled to a diameter of less than 1½ in.

After completion the machine was thoroughly tested by satisfactorily boring a duplicate hole through a full-size model of the bridge truss connection set up in the shop. The steel was cut at the rate of about 6 lb. per minute, which is believed to be the most rapid boring on record. The first cut, through 24 lin. in., was made in a minimum of 56 min. and the finishing cuts in a minimum of 45 min.

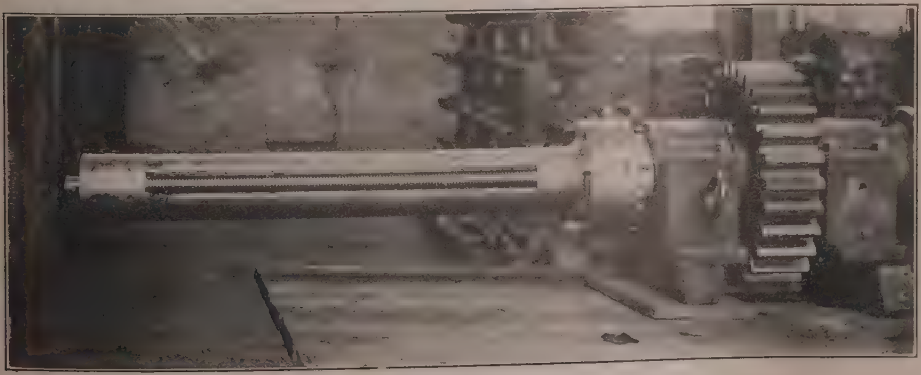
All of the cutting tools were set parallel to the boring bar except the finishing tool, which was slightly inclined so that a little longitudinal adjustment varied the diameter of the hole to secure the exact clearance required, between 1/32 and 3/64 in. larger than the diameter of the new pin. The tools were lubricated by a solution of soft soap, soda and water delivered through a 1-in. hose and ¼-in. nozzle under a pressure head of about 40 ft. supplied from four barrels on the top chord of the truss.

MOUNTING

The machine was operated with the boring bar passing horizontally through the old pinholes in the lower part of vertical posts L29-U29 in the planes of the floorbeams, which were partly cut away to provide clearance for it. The outer end of the boring bar was journaled in two bearings bolted to a frame which was connected to the face of the vertical post of the bridge truss, and the inner end was journaled in a bearing bolted to the web of the main floorbeam between the trusses. This web was originally cut to clear the old pin nut and was afterward cut out further to provide additional clearance for the boring. Part of the roadway floorbeam bracket on the outside of the truss was removed and in its former position two horizontal brackets transverse to the bridge axis were securely bolted to the face of the vertical post and received a short riveted vertical post carrying the front bearing for the boring bar and the driving gears operated by a Morse silent chain from the 35-hp C & C electric motor installed on the bridge floor.

The vertical post was bolted to the upper bracket through slotted holes, providing for vertical and horizontal adjustment, and the lower end was seated on folding wedges and secured by horizontal setscrews on opposite sides, thus enabling it to be adjusted in any direction. After the adjustments were completed the lower end of the post was further secured by clamping an inclined strut to the next panel of the bridge truss.

To expedite the work the machine was installed and all possible adjustments were made before the old pin was removed. After it was removed the boring bar was swung to position by a differential hoist, and the final adjustment was accomplished in about 15 min. by the eight bolts on the vertical posts and at the rear bearing.



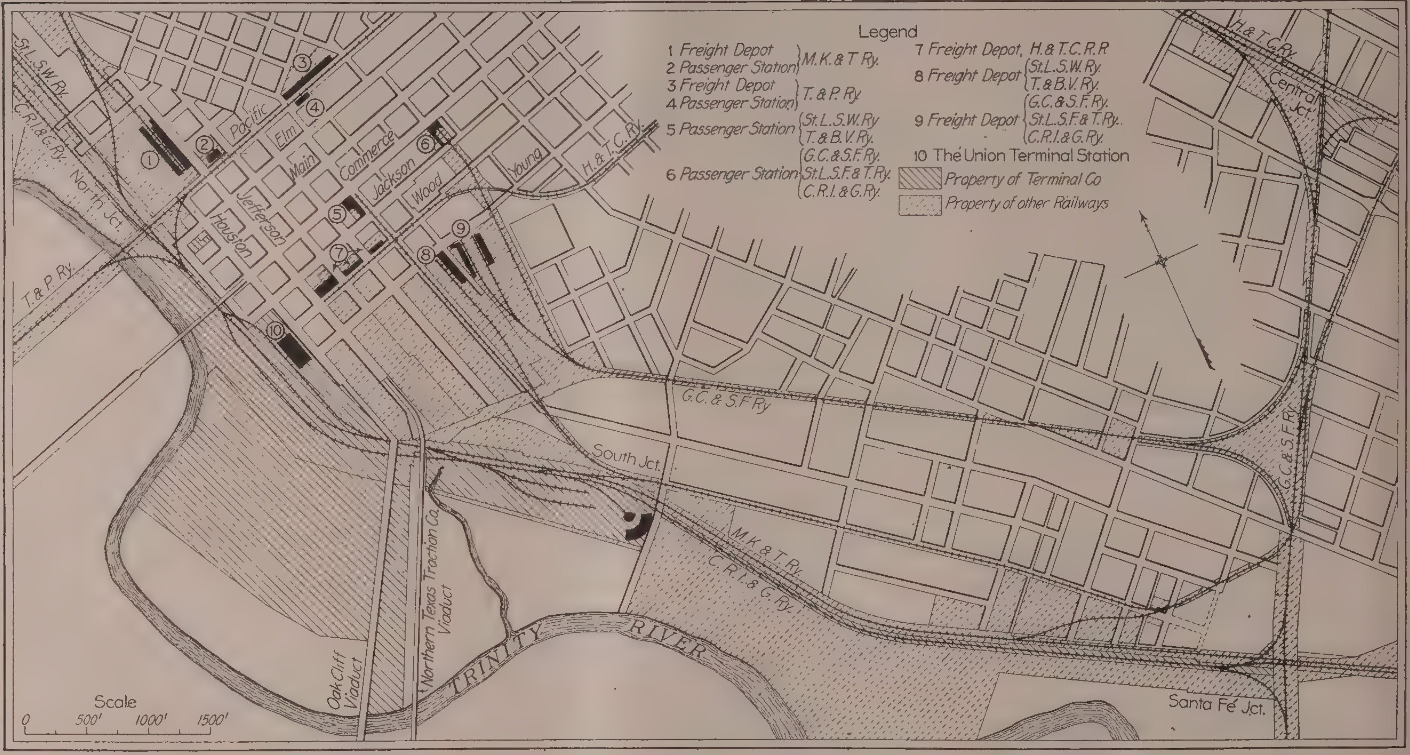
VIEW OF BORING BAR, 7 FEET LONG, AND FEED SCREW IN GROOVE

MATERIAL INTERCEPTED at the screens at the north metropolitan sewerage stations in Boston, consisting of rags, paper and other floating materials, during the year 1913 amounted to 4056 cu. yd. This is equivalent to 5.3 cu. ft. for each 1,000,000 gal. of sewage pumped at Deer Island. The material intercepted at the screens at the south metropolitan sewerage stations amounted to 2,517.27 cu. yd., equal to 3.51 cu. ft. per 1,000,000 gal. of sewage delivered at the outfall works at Nut Island. Studies of the sewage flows indicate that the metropolitan sewers and siphons are free from deposit, according to the recently published annual report of Frederick D. Smith, engineer of sewerage works.

Dallas Union Terminal

Nine Railroads, Operating Five Separate Stations, Will Come Together and Use Joint Facilities Convenient to All

CONSTRUCTION has been started on a union passenger terminal at Dallas, Tex., to serve the nine railroads entering the city, replacing the five stations now in use. The project is the result of seven years of negotiation. The decision was made in 1912 to build on Houston Street at Wood and Young Streets, on a new right-of-way. The railroads involved have united to form the Union Terminal Company, which has acquired the necessary land or leased it from the individual roads, and will build and operate the terminal.



GENERAL RAILROAD MAP OF DALLAS, SHOWING LOCATIONS OF OLD FACILITIES AND NEW UNION TERMINAL

The locations of the existing lines and terminals are shown on the map. The present stations are in two groups, two—that of the Missouri, Kansas & Texas and that of the Texas & Pacific—being on the north side of the business district and the other three on the south side. Of the latter, the St. Louis Southwestern of Texas and the Trinity & Brazos Valley have a dead-end station on Commerce Street, and the Gulf, Colorado & Santa Fé, the St. Louis, San Francisco & Texas and the Chicago, Rock Island & Gulf have another on the same street. The Houston & Texas Central, over which the Texas & New Orleans has trackage rights, crosses the approaches to these two terminals and reaches a freight terminal at Young and Jefferson Streets, the passenger station being about 1 mi. east of the Texas & Pacific station. The roads entering the Commerce Street terminals have freight houses on Young Street, three blocks south of Commerce, and own all the land from there south between Houston and Desoto Streets. The remaining roads have freight facilities near their stations.

The new terminal and its approaches will be largely on land leased from the individual roads, although additional land costing $1,750,000 has been bought. The station will be of the through type, with ten platform tracks and two outside main tracks for present installation. These are ultimately to be increased to eighteen and four. The Missouri, Kansas & Texas, the St. Louis Southwestern, the Rock Island, the Trinity & Brazos Valley and the St. Louis, San Francisco & Texas now traverse the site throughout its length, hence they will enter the new terminal without difficulty. The Texas & Pacific crosses just north of the north throat, and to gain entrance to the terminal will have to build a wye, which will include a new bridge over the Trinity River. The Houston & Texas Central will build a connection with the Missouri, Kansas & Texas south of Santa Fé Junction, and will leave at the north at Katy Junction, about 4 mi. north of North Junction. The Texas and New Orleans will cross from the Houston & Texas Central to the Gulf, Colorado & Santa Fé by a new wye at Central Junction. The St. Louis, San Francisco & Santa Fé will enter from the north over the Rock Island and depart to the south over the Santa Fé. The Trinity & Brazos Valley will enter from the north over the Rock Island and depart at the south over the Missouri, Kansas & Texas.

FLOOR ARRANGEMENT

The station will be a three-story granite-and-brick structure 282 ft. long and 135 ft. wide. The first floor will be occupied by the ticket office and lobby, baggage and parcel rooms and an emergency hospital. The waiting rooms will be on the second floor, whence a bridge 36 ft. wide will lead over the tracks, with stairways to each platform. There will also be two 15-ft. baggage bridges. The main waiting room for whites will be 70 x 135 ft. Offices and the restaurant will occupy the third floor. South of the station there will be erected an express building 50 x 500 ft.

The tracks will be in pairs on alternate centers of 13 and 28 ft., with 18-ft. platforms. They will accommodate from fourteen to twenty 70-ft. coaches, and will be protected with reinforced-concrete sheds of the butterfly type. At each end of the layout there will be four lead tracks. The outside main tracks are for freight service.

Coach-storage yards and engine terminals will be provided at South Junction, but the details are not yet determined.

Flood conditions on the Trinity River make it advisable to have the tracks as high as possible, and in order to minimize the cost of crossings a clearance of 18 ft. over top of rail was established. Clearance at the Oak Cliff concrete-arch viaduct built four years ago will be reduced from 22 to 18 ft. by raising the tracks. The viaduct at Commerce Street will be raised. The Northern Texas Traction Company, which now crosses at grade, will build a concrete overcrossing. The Texas & Pacific north of the station will continue to cross at grade, as the cost of separating the grades is considered prohibitive at this time.

The general contract for the work is held by J. W. Thompson, of St. Louis. The work is being done under the direction of C. H. Dana, chief engineer of the Union Terminal Company.

BORAX KILLS FLY EGGS, and about 2 oz. per garbage can will prevent flies from breeding. This is the announcement made recently by the Department of Agriculture. Propagation in stables, garbage piles, rubbish heaps and in fertilizer can now be prevented cheaply without lessening the value of the decaying matter for use by the farmer. Borax, to the amount of 0.62 lb., or calcined colemanite (crude calcium borate), 0.75 lb., was found by experiment to eliminate breeding of flies in 8 bu. of fertilizer. It is believed that this discovery will assist health authorities in campaigns against the typhoid fly. Contractors should welcome the method as an aid to keep construction camps free from flies.

Formulæ for Wind Stresses

Analysis of System of Horizontal Girders and Knee Bracing Worked Out in Design of Thirty-eight Story Office Building

By DAVID GUTMAN
Chief Engineer for John G. Brown, Philadelphia

IN the design of tall buildings one feature which entails considerable labor of calculation is the wind bracing. As a rule, the main systems of bracing are located in the exterior walls, where they can best be concealed. On account of the window openings the only bracing possible is horizontal girders with knees at the ends connecting to the columns. The horizontal girders carry the walls as well as take care of the wind stresses. In this article the writer gives an example of such bracing used by him in the design of a thirty-eight-story office building.

In figuring portal bracing of this type there are two general methods in use. In the one the horizontal shear on any column at any point is assumed to be equal to the total horizontal shear on the bent divided by the number of columns in the bent. In the other method the analysis is as given below. This analysis in no way differs from that given in an article by A. C. Wilson in the Engineering Record of Sept. 5, 1908, page 272, except that in deriving the formulæ for the various bending moments in the columns and girders the use of a quantity which he calls effective depth was found cumbersome and in no way necessary, and was therefore eliminated. The points of contraflexure of the girders and columns are assumed to be midway between the ends of adjacent knees.

ANALYSIS OF WIND BRACING

Let P_n, P_{n+1}, etc., = panel loads at the nth, (n + 1) th, etc., floors; H_n, total horizontal shear at nth floor = $P_n + P_{n+1} + P_{n+2} + \ldots$; $T1_n$, tension in column 1 at nth floor; $T2_n$, tension in column 2 at nth floor; $C3_n$, compression in column 3 at nth floor; $C4_n$, compression in column 4 at nth floor; M_n, bending moment of entire bent at nth floor, and V, distance of column 4 from neutral axis.

To find V take moments about column 4 in Fig. 1. Then

$$V = \frac{(b+c+d)+(c+d)+d}{4\ (=\text{number of columns})} = \frac{b+2c+3d}{4}$$

Having solved for V, the other distances become known. Thus $a = v - d$, $p = b + c - a$ and $r = c - a$.

To find the direct stresses in the columns, take moments about k in Fig. 1. Thus

$$T1_n\,p + T2_n\,r + C3_n\,a + C4_n\,v = M_n \quad (1)$$

Now $T1_n$, $T2_n$, $C3_n$ and $C4_n$ vary as p, r, a and v. Therefore

$$T2_n = T1_n(r/p) \quad (2)$$

$$C3_n = T1_n(a/p) \quad (3)$$

and

$$C4_n = T1_n(v/p) \quad (4)$$

Substituting the values in equations (2), (3) and (4) in equation (1),

$$M_n = T1_n\,(p) + T1_n\,(r/p)r + T1_n\,(a/p)a + T1_n\,(v/p)v = T1_n\,(p^2+r^2+a^2+v^2)/p$$

therefore

$$T1_n = \frac{M_n\,p}{p^2+r^2+a^2+v^2} \quad (5)$$

and from equations (2), (3) and (4)

$$T2_n = \frac{M_n\,r}{p^2+r^2+a^2+v^2} \quad (6)$$

$$C3_n = \frac{M_n\,a}{p^2+r^2+a^2+v^2} \quad (7)$$

and

$$C4_n = \frac{M_n\,v}{p^2+r^2+a^2+v^2} \quad (8)$$

Also

$$M_n = P_n\,h_n + P_{n+1}\,h_{n+1} + P_{n+2}\,h_{n+2} + \ldots (9)$$

From equations (5), (6), (7) and (8) it is seen that the direct stress in any column at any floor is equal to the bending moment of the bent at that floor multiplied by the distance of the column from the neutral axis and divided by the sum of the squares of the distances of all the columns from the neutral axis.

SHEARS IN GIRDERS AT NTH FLOOR

Let $S1_n$, $S2_n$ and $S4_n$ = shear at center of girder between columns 1 and 2, 2 and 3 and 3 and 4 respectively. Then

$$S1_n = T1_n - T1_{n+1} \quad (10)$$

$$S2_n = S1_n + (T2_n - T2_{n+1}) \quad (11)$$

$$S4_n = C4_n - C4_{n+1} \quad (12)$$

and

$$S2_n = S4_n + (C3_n - C3_{n+1}) \quad (13)$$

To find the shear in columns at point of contraflexure let $L1_n$ = shear in column 1 between the nth and (n — 1) th floors (Fig. 2). Then, since the shears in any two sections of the column will vary as the total horizontal shears of those sections, the shear in column 1 between the nth and (n + 1) th floors = $L1_n\,H_{n+1}/H_n$ and $L1_n - L1_n H_{n+1}/H_n$ will equal the increment of shear at the nth floor. These three horizontal shears and the vertical shear $S1_n$ hold the joint in equilibrium.

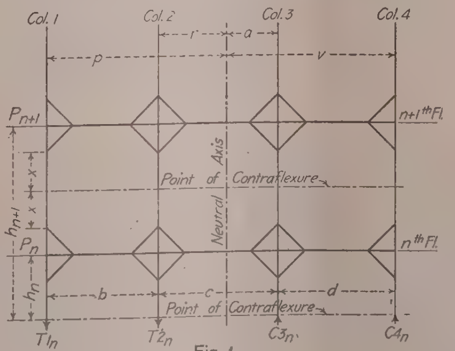


Fig. 1

Taking moments about j,

$$L1_n\left(\frac{H_{n+1}}{H_n}\right)(e+f) + \left[L1_n - L1_n\left(\frac{H_{n+1}}{H_n}\right)\right] f = S1_n\left(\frac{b}{2}\right)$$

$$L1_n = \frac{S1_n\,b/2}{e\left(\frac{H_{n+1}}{H_n}\right)+f} \quad (14)$$

$$L2_n = L1_n + \frac{S2_n\,c/2}{e\left(\frac{H_{n+1}}{H_n}\right)+f} \quad (15)$$

$$L3_n = \frac{S2_n\,c/2}{e\left(\frac{H_{n+1}}{H_n}\right)+f} + \frac{S4_n\,d/2}{e\left(\frac{H_{n+1}}{H_n}\right)+f} \quad (16)$$

and

$$L4_n = \frac{S4_n\,d/2}{e\left(\frac{H_{n+1}}{H_n}\right)+f} \quad (17)$$

DIRECT COMPRESSION IN GIRDERS AT NTH FLOOR

Let $G1_n$ = direct compression in girder between columns 1 and 2; $G2_n$, direct compression in girder between columns 2 and 3, and $G3_n$, direct compression in girder between columns 3 and 4. Then

$$G1_n = P_n - [L1_n - L1_n\,(H_{n+1}/H_n)] \quad (18)$$

$$G2_n = G1_n - [L2_n - L2_n\,(H_{n+1}/H_n)] \quad (19)$$

and

$$G3_n = G2_n - [L3_n - L3_n\,(H_{n+1}/H_n)] \quad (20)$$

MAXIMUM MOMENT IN GIRDER

Maximum moment = shear times distance from end of knee to center of girder. To this must be added moment of floor and wall loads at end of knee. In Fig. 2 maximum moment = $S1_n(w)$.

STRESSES IN KNEES

From Fig. 2

$$K1_n = \tfrac{1}{2}\,b\,(S1_n - S1_{n+1}) \quad (21)$$

The bracing is not carried beyond the thirtieth floor, as a building of the height from this point to the roof (eight stories) would not, according to the New York code, require any bracing. The point marked roof on the diagram is really the top of a high balustrade. In this building the kneebraces were made of wing plates which formed part of the web of the column and girder, the columns being I-shaped. The writer has found that an I-shaped column

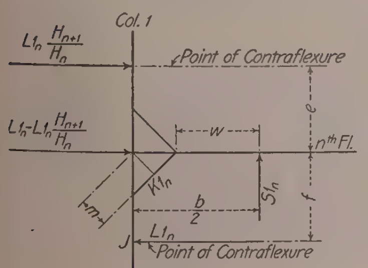


Fig. 2

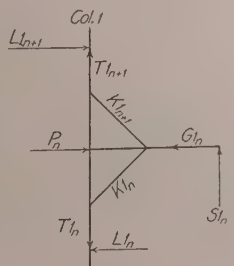


Fig. 3

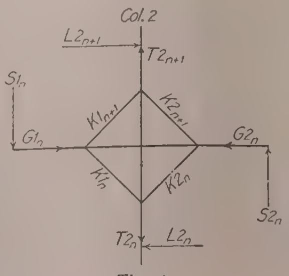


Fig. 4

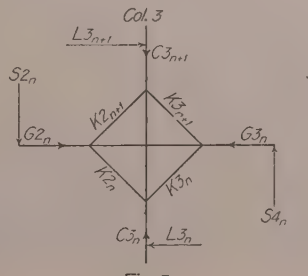


Fig. 5

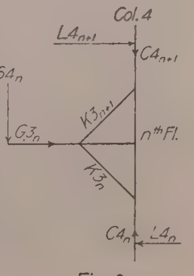


Fig. 6

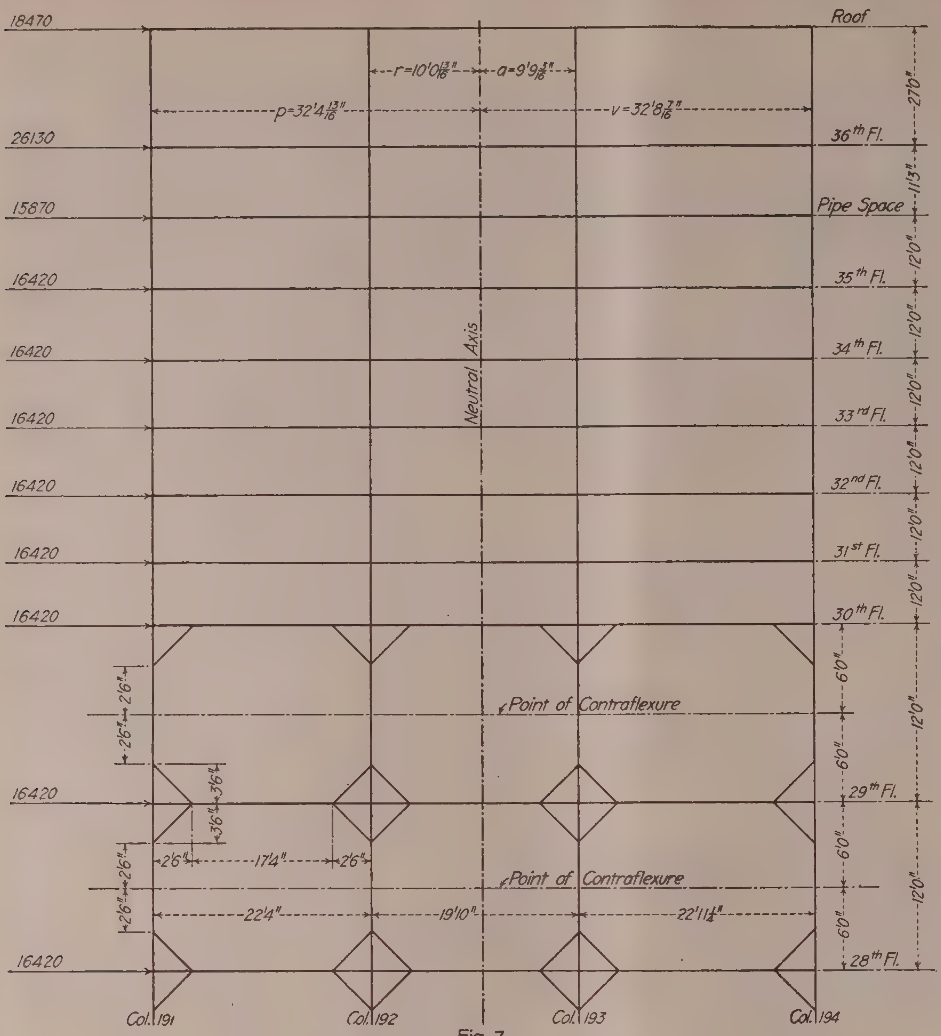


Fig. 7

Distance from interior bent = 91 ft. 2 5/16 in.
Wind load = 30 lb. per square foot.

$$V = \frac{22\text{ ft. }4\text{ in.} + 2\,(19\text{ ft. }10\text{ in.}) + 3\,(22\text{ ft. }11\tfrac{1}{4}\text{ in.})}{4} = 32\text{ ft. }8\ 7/16\text{ in.}$$

is in general more satisfactory than one which is box-shaped. Whatever economy the latter has due to its radii of gyration being equal in both directions is generally lost through its greater cost of fabrication and more cumbersome connections. Where columns receive a wind load in one direction only, the I shape is particularly well adapted to take care of the bending due to the knees.

SHEARS AND MOMENTS

The first step in calculating the stresses shown in Fig. 7 is to make a table of total horizontal shears. Next a table of bending moments is made. For this formula (9) could be used, but since the wind is a uniform load, the moment is found by multiplying H_n by half the distance between the nth floor and the roof. Therefore in a column next to H a column of these distances is made. For the thirtieth floor this is 116 ft. 3 in. ÷ 2 = 58 ft. 1½ in. Having H and its lever arm, a schedule of moments can readily be made.

From these moments the direct stresses are computed by formulæ (5), (6) (7) and (8). The slide rule is set at the ratio $p/(p^2 + r^2 + a^2 + v^2)$ and the direct stress read off by multiplying by the moment of each floor. The stress in each succeeding column is found in the same way.

A table of shears, moments and direct stresses can thus be made very rapidly. By substituting in formulæ (10) (11), (12) and (13), the shears in the girders are obtained, and from these shears the bending moment. To this moment the moment due to the floor and wall loads must be added. This quantity must be compared with the maximum bending moment due to the floor and wall alone; as this latter comes as a rule in the center of the girder and may be larger than the aforementioned moment. Formulæ (18), (19) and (20) will give the direct compressive stresses in the girder. These latter stresses, as will be seen from the formulæ, are always less than one panel load and as a rule will be too small to influence the design of the girders.

Formulæ (14), (15), (16) and (17) will give the shears in the columns. The shear times half the distance between the ends of the knees in the story will give the bending moment. The effect of the wind is to produce compression in the columns on the leeward side of the neutral axis and tension in those on the windward side. Inasmuch, however, as the wind can be assumed as blowing on either side, the direct stresses as found can all be considered compressive, the only part the tensile stresses play being in the design of the column splices. It is of course assumed, as would happen in any ordinary design, that the uplift is less than the direct load from walls and floors. The columns are therefore designed for the direct wind stresses, the bending due to the knees and the floor and wall loads. In this particular case the end elevation of the building consisted of two such bents as shown in Fig. 7 with a court between. It was illogical to assume that the wind could be reversed and considered as blowing directly on column 194, as the bent on the other side of the court would prevent this. The only way columns 191 and 192 could get any compressive stresses would be by the wind blowing diagonally into the light court—this court being about 28 ft. wide—at an angle of 45 deg. with the plane of the bent. This wind, it was assumed, would produce compressive stresses equal to about one-half the tensile stresses produced by the wind blowing as shown in Fig. 7.

ASSUMPTIONS AND ANALYSIS

The assumptions made in the formulæ are that the areas and section modulii of all columns of the same story are alike, that the section moduli of all girders of the same story are alike and that the points of contraflexure in the columns and girders are midway between the ends of the knees. This would mean, in the case of the columns, that every column except one which came upon the neutral axis would have to be designed to take the maximum load coming on any column in that story. The writer has met some stanch believers in the soundness of the foregoing analysis who nevertheless did not follow out the as-

TABLE OF COLUMN STRESSES

Floor	H	Half distance from point of contraflexure to roof	M	T1 (Col. 191) $\frac{p}{p^2+r^2+a^2+v^2} = 0.01389$	T2 (Col. 192) $\frac{r}{p^2+r^2+a^2+v^2} = 0.00435$	C3 (Col. 193) $\frac{a}{p^2+r^2+a^2+v^2} = 0.00421$	C4 (Col. 194) $\frac{v}{p^2+r^2+a^2+v^2} = 0.01412$
30	159,000	58 ft. 1½ in.	9,264,000	130,000	40,000	39,000	131,000
29	175,400	64 ft. 1½ in.	11,271,000	158,000	49,000	48,000	159,000

$$S1_{29} = 158{,}000 - 130{,}000 = 28{,}000$$
$$S2_{29} = 49{,}000 - 40{,}000 + 28{,}000 = 37{,}000$$
$$S4_{29} = 159{,}000 - 131{,}000 = 28{,}000$$

$$L1_{29} = \frac{28{,}000 \times 11\text{ ft. }2\text{ in.}}{6\left(\frac{159{,}000}{175{,}400}\right) + 6} = 27{,}300$$

$$L2_{29} = 27{,}300 + \frac{37{,}000 \times 9\text{ ft. }11\text{ in.}}{6\left(\frac{159{,}000}{175{,}400}\right) + 6} = 59{,}400$$

$$L3_{29} = \frac{37{,}000 \times 9\text{ ft. }11\text{ in.}}{6\left(\frac{159{,}000}{175{,}400}\right) + 6} + \frac{28{,}000 \times 11\text{ ft. }5\tfrac{5}{8}\text{ in.}}{6\left(\frac{159{,}000}{175{,}400}\right) + 6} = 32{,}100 + 28{,}100 = 60{,}200$$

$$L4_{29} = \frac{28{,}000 \times 11\text{ ft. }5\tfrac{5}{8}\text{ in.}}{6\left(\frac{159{,}000}{175{,}400}\right) + 6} = 28{,}100$$

Maximum moment in girder at 29th floor between cols. 191 and 192 = 28,000 × ½ (17 ft. 4 in.) = 242,000 ft. lb.
Maximum moment in col. 191 in 28th story = 27,300 × 2 ft. 6 in. = 68,300 ft. lb.

sumptions on which the analysis is based.

In an article on wind bracing in the "Engineering News" of March 13, 1913, R. Fleming points out one of the inconsistencies of the analysis. He says "the assumption as to location of points of contraflexure would make the distorted shape of panel constant in any given story, and from this would follow that the column shears themselves must be equal; but the calculation gives column shears of different amount." That the analysis is not entirely consistent is evident to one who studies it. On the other hand this is true of all other methods the writer has seen—at least of those that are practically workable.

Machine for Testing Brick

Sandblast Principle Is Employed in Apparatus Described by Mont Schuyler before American Society for Testing Materials

FACILITY of standardization is designated in a paper read before the American Society for Testing Materials on July 2 by Mont Schuyler, of the St. Louis Municipal Laboratory, as the important advantage of a method proposed by him for testing "brick value." The parallelism between rattler loss on paving brick and the indications furnished by the sandblast has been fairly well established, he states, by L. W. Page, director of the Office of Public Roads. But wear of nozzle, the trouble of keeping the air pressure constant and the cost of equipment have made this method one not easy of standardization and have prevented its wider acceptance.

Mr. Schuyler's paper, which is here abstracted, describes an apparatus (first proposed in 1911 by the author to Committee C-4) which generates the same destructive forces as the sandblast, but has the advantage of being easily and cheaply duplicated; and in addition a method of standardization is proposed which may make it possible to use sands of widely varying origin and character.

SAND FEED

The apparatus consists of a base on which is mounted a ring for retaining the specimens to be tested. Centrally located is a spindle, rotated from below by a motor. Sand is fed into the spindle from above and is projected outward against the specimens through the tubes attached to the spindle. A sheet metal cover is used when the machine is in operation.

Two different sands have been tried on this machine, one being standard Ottawa sand, the other a crushed quartz passing a No. 8 sieve. There is quite a different rate of loss using these two sands, but it is probable that this is due more to the difference in grain size than to varying degree of sharpness. A close analysis of the losses on such widely varying materials as wood, hard-burned brick, vitrified brick, and glass seems to show that the indications furnished by the machine are the result of resistance to impact, rather than abrasion. For instance, plate glass suffers more than the slow-growth rings of yellow pine. Furthermore, the very decidedly over-burned vitrified brick suffers a greater unit loss than a brick burned to the correct degree. One of the figures shows the action of 10 lb. of the crushed quartz upon six dry-pressed bricks burned to various degrees.

The test rates them exactly as does the brick manufacturer and the absorption test, but not as the cross-breaking or compressive test, as may be seen from Table 1.

TABLE 1—ACTION OF CRUSHED QUARTZ UPON DRY-PRESSED BRICKS

Manufacturer's grading	Abrasion loss, g. 1½ in. from end	Abrasion loss, g. 3 in. from end	Modulus of rupture, lb. per sq. in.	Compressive strength, lb. per sq. in.	Absorption, per cent
Straight, hard	4.0	4.0	530	8400	5.1
Ordinary ...	9.0	9.5	830	4840	8.9
Medium No. 1	10.5	10.0	970	6740	10.0
Medium No. 2	17.0	17.5	830	4180	12.4
Light red ..	21.0	20.0	400	4740	14.2
Salmon	55.0	55.0	245	2240	18.1

An attempt has been made to standardize the machine against plate glass, which is probably of sufficient uniformity to warrant its use for this purpose. Throughout the various tests the time required to feed 10 lb. of quartz sand was noted by means of a stopwatch, and the number of grams lost by the plate glass were found to vary with the time of the test. Since a series motor is used in this machine, it is evident that the slower the feed the greater will be the speed of the motor, and hence the greater the velocity of the sand grains. The results are shown in Table 2.

The phenomenon being probably that of impact, the conclusions are obvious.

To prove this point the rate of feed was reduced 70 per cent, with the result that the glass showed an increase in loss of 32 per cent, and brick, which had been tested previously at the usual rate, showed an increase in loss of 35 per cent.

In succeeding machines the motor, therefore, should be of the constant-speed type, and the rate of sand feed should be kept constant. By this means it is extremely probable that closely concordant results could be obtained.

A slight variation in the moisture content of the brick has no appreciable effect upon the impact losses. This, together with the fact that a test can be made in 15 min., and without noise or dust, would make the apparatus of great convenience and utility in laboratories where clay products are under test.

TABLE 2—LOSSES OF PLATE GLASS, 1 x 3 INCHES, EXPOSED TO ACTION OF SAND

(10 lb. of quartz sand passing No. 8 sieve used.)

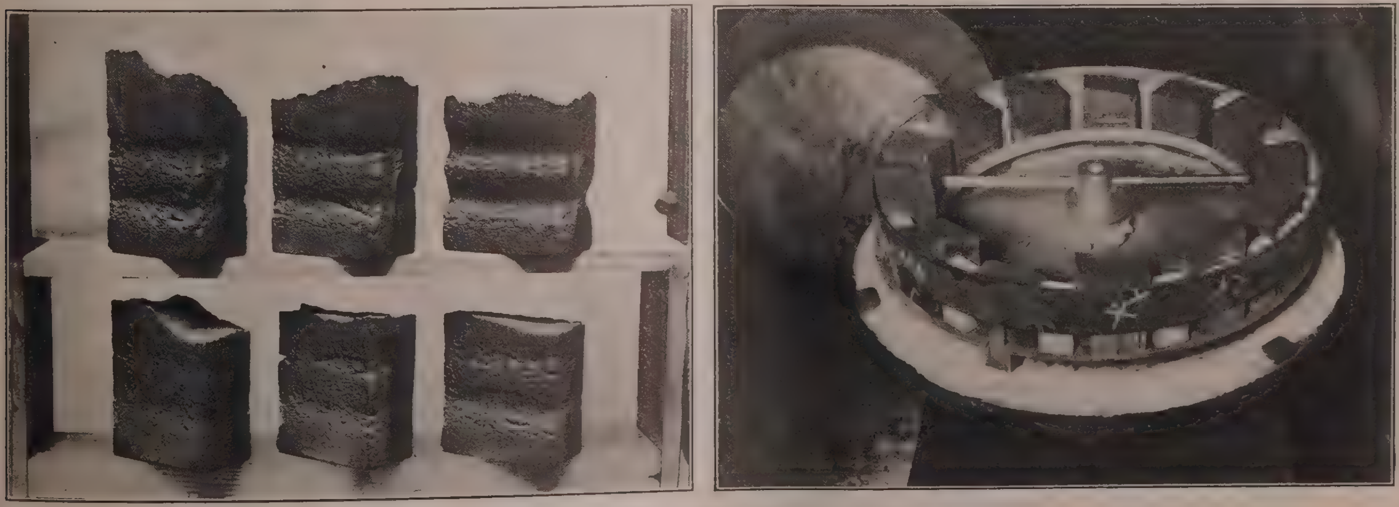
Time, sec........	60	62	62	65	61
Loss, g.	2.1	2.2	2.2	2.4	2.2
Time, sec........	60	60	59	204	
Loss, g.	2.1	2.2	2.1	2.9	

An apparatus of this sort can be built for not over $60 or $70. It is portable and easily standardized and requires very little renewal beyond an occasional changing of the radial tubes at a cost of not more than $1.

The author has not presented tables of data, for the reason that there is still much work to be done in standardizing various details and dimensions. It is hoped that this work will prompt other investigators to undertake more extensive tests than have been found possible up to this time in the Municipal Testing Laboratory of St. Louis.

Leaky Check Valve Causes Typhoid

CONNECTION between the domestic water supply and a polluted manufacturer's supply in Circleville, Ohio, a town of 7000 inhabitants 25 miles below Columbus on the Scioto River, caused a typhoid outbreak last January, according to a report by W. H. Dittoe and F. G. Boudreau in the Ohio State Board of Health bulletin for July. Both water company and manufacturer had a gate valve on the line, but each valve was left open, reliance being placed on a check valve to hold back the high pressure which the manufacturer frequently maintained. Upon examination it was found that the check valve was in a leaky condition and was permitting a rather large volume of polluted water to enter the mains. Since closing the gate valves and sealing them by order of the health authorities no further cases developed.



SPECIMENS TESTED AND VIEW OF MACHINE, SHOWING ARRANGEMENT OF SAND TUBE, WHICH IS ROTATED BY MOTOR

Hell Gate Arch Skewbacks

Details of Sectional Cast-Steel Bearings for the 977½ Foot Span

The skewback bearings at the ends of the lower chords of the 977½-ft., four-track, spandrel-braced arch span of the Hell Gate Bridge not only support the 26,000-ton weight of the superstructure but resist the enormous thrust developed, and are very important members of the structure. They are different from the bearings of any other span of comparable magnitude and are of a type notably different from those of the other longest arch spans in this country. They consist of massive cast-steel sectional pyramids, here illustrated, which are designed to concentrate the stresses in the centers of the arch ribs and distribute them over the large inclined areas of the masonry bearings.

Each arch-truss lower chord is designed for a maximum compressive stress of 28,650,000 lb. and has at the end a hollow rectangular section about 6½ x 11½ ft. over all, reinforced by a horizontal transverse diaphragm at the center, this diaphragm having a total area of 1385 sq. in. The principal elements of this section are the two side webs, reinforced to a maximum thickness of 5⅝ in. at the end and stiffened with end and center longitudinal flange angles, which afford connections for the cover plates and diaphragms. The skewback end is faced square with the axis and is flange-bolted to the 7 x 11-ft. planed inclined surface of a cast-steel shoe 5 ft. high. The shoe has two full-length main ribs 8 in. thick in the planes of the chord webs, a center web parallel to them and a center transverse web in the plane of the corresponding chord member. These webs and the inclined webs integral with them unite in the 3 x 9½-ft. contact surface, which is slightly divergent from a parallel with the bolted surface, and which engages the convex bearing surface of the pedestal.

The pedestal, 12½ ft. high in the axis of the chord, has a 17½ x 17½-ft. bearing on the surface of the abutment masonry inclined 45 deg. from the vertical. This provides an area of 306 sq. ft., which reduces the pressure on the masonry to 50 tons per square foot. The pedestal consists of three rectangular cellular cast-steel sections of about equal height, with their inclined top and bottom surfaces accurately planed and bolted together. The load is transmitted through longitudinal and transverse webs, generally 3 in. thick. The planed flat surface of the upper section receives the chord shoe with a cylindrical surface planed to a radius of 1150 in., thus theoretically confining the contact to cylindrical elements on the center line of the bearing, eliminating eccentricity from the rise and fall of the arch due to temperature variations, and also insuring clearance at the upper and lower edges.

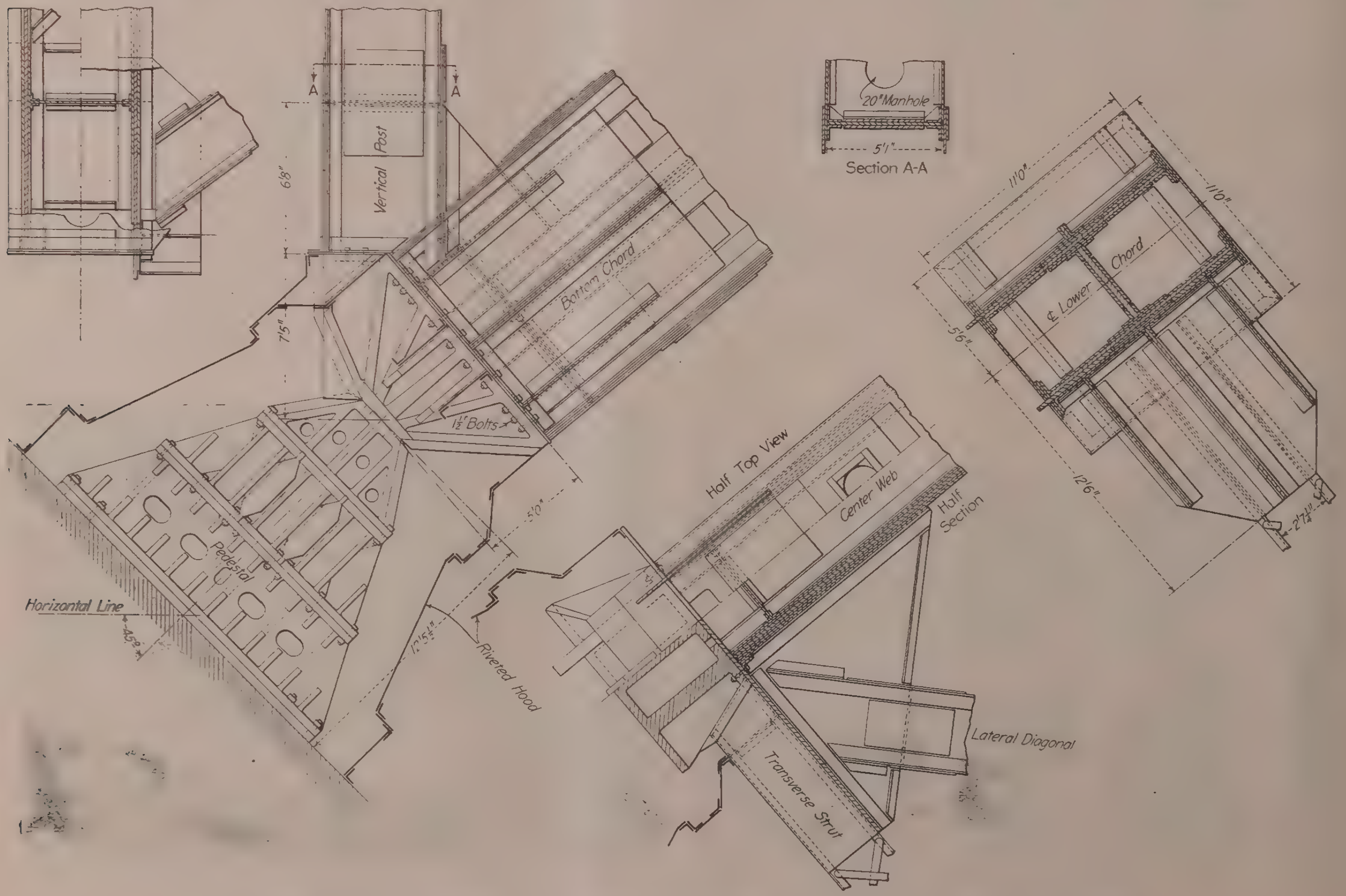
Pedestals

The total weight of one pedestal and shoe is 250 tons. The heaviest section of the pedestal weighs 28 tons. The pedestals on the same pier are connected by a light horizontal transverse strut with wide gusset plates, which are riveted to the lower chords and receive the end lateral diagonals, thus transmitting the stresses from the latter directly through the pedestals to the pier masonry. The pedestals are entirely inclosed by a riveted steel casing.

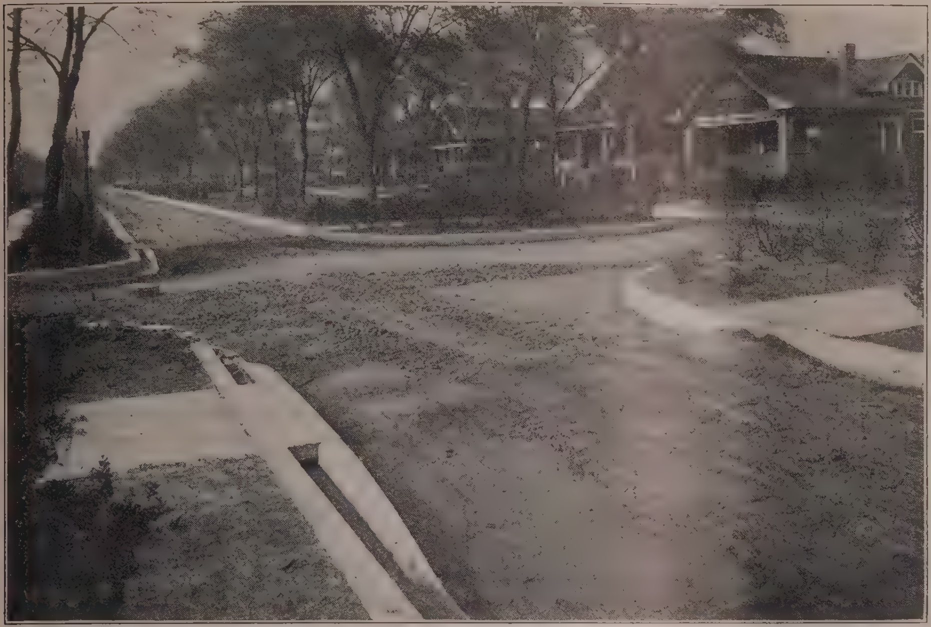
Samuel Rea is president of the New York Connecting Railroad, of which the Hell Gate Bridge is a part. Gustav Lindenthal is consulting engineer and architect. Mr. Lindenthal designed the bridge and is acting as chief engineer of construction. O. H. Ammann is assistant chief engineer and H. W. Hudson construction engineer. The American Bridge Company is contractor for the fabrication and erection of the steel work, the P. Ryan Construction Corporation is the contractor for the tower bases, the Snare & Triest Company is the contractor for the towers, and the deep foundations for the Ward's Island tower were constructed by the railway company on force account under the direction of G. Lindenthal, with P. G. Brown acting as managing engineer.

Photographing Blueprints

Photographing of engineers' or architects' blueprints is not an easy task without the proper plate and color filter, it being impossible to produce satisfactory results by using the ordinary plate. B. N. Rhoads, photographer, of La Salle, Ill., has found that ordinary orthochromatic plates, with yellow filters, do not give the best results with such a subject, owing to the fact that a great deal of the yellow-green light to which such plates are sensitive is reflected by the blueprint. This trouble has been eliminated and satisfactory results have been obtained by using a deep-red filter with panchromatic plates, thus photographing the print by red light, which completely absorbs the blue. With such a filter and plate the negatives made from blueprints have been found to be as satisfactory as could be obtained from photographing a black-and-white print in the ordinary way. The photography of purple or violet typewriting can be accomplished by using a green filter and plate.



CAST-STEEL SHOE AND PEDESTAL OF LOWER-CHORD SKEWBACK BEARING IN STEEL-PLATE CASING



NARROWED DOUBLE ROADWAYS IN CHICAGO WITH ELEVATED CROSSING GUTTER SLABS

Recent Paving Practice in Chicago

Reduction in Width of Roadway Where Permissible; Artistic Effect Obtained in Crowning; Pitch Filler Found Most Satisfactory

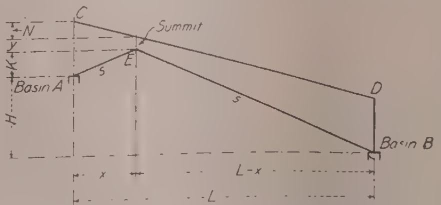
By A. J. SCHAFMAYER
Division Engineer, Bureau of Local Improvements

ECONOMY prompted the city of Chicago to adopt the practice several years ago of reducing the width of roadways in repaving residence streets wherever such reduction is deemed permissible. The usual roadway on a 66-ft. street in Chicago was formerly 38 ft., while the width in most common use now on the average residence streets is 30 ft. This alone effects a saving in first cost of 8 sq. ft., or almost 1 sq. yd. of pavement per linear foot of frontage on each side, not counting the saving in excavation. The narrower roadway also reduces the cost of cleaning. From the standpoint of maintenance the advantage of the narrow roadway depends chiefly on the material. To a certain extent the cost of maintenance varies with the density of the traffic. With certain paving materials, however, such as sheet asphalt or creosoted wood blocks, the pavement needs a moderate amount of traffic to keep it in its best condition. Old roadways of 50 ft. width have been cut down to 38 ft. and 34 ft. Old 38-ft. roadways have been reduced to 32, 30 and 28 ft., and many pavements have been built with roadway widths of 26 and 24 ft.

While the general tendency has been to reduce the width of roadways on residence streets, it has been somewhat the reverse on streets with car tracks. In this case the usual roadway width on a 66-ft. street was formerly 38 ft. between curbs, leaving about 11 ft. on each side of the street cars. Now, however, since the introduction of the large modern street cars and the advent of the mammoth motor trucks, the minimum width recommended is usually 42 ft., and greater widths are very often recommended, depending on the width of the street, the traffic and local conditions.

The streets in Chicago have in general very little longitudinal slope and many of them run at a level grade for considerable distances. Hence to obtain a fall in the gutters sufficient for drainage purposes the depth of the gutters below the top of the curb is decreased from the basins to summits placed at intermediate points. This is considered preferable to the other expedient of springing a summit in the entire pavement and curb, as is done in alleys, and carrying the gutters a uniform distance below the curb grade. The pavements built in Chicago in recent years have been designed to avoid deep gutters and steps at crosswalk intersections. Instead a summit is placed at each crosswalk with just enough dish in the gutter to contain the water. The gutter then slopes down to a shallow inlet at the catchbasin at the curb corner. In the other direction it descends to the catchbasin located from 100 to 125 ft. along the block.

The standard gutter slope used is 0.5 per cent. The location of the summit between the basins depends upon the gutter slopes and the difference in elevation of the inlets. If these slopes are equal and the inlets are at the same elevation the summit will naturally come halfway between inlets. If one inlet is higher than the other the summit will be nearer the high inlet. As an example, suppose two inlets are 150 ft. apart, one being 0.2 ft. above the other, and suppose the proposed gutter slopes are to be 0.4 per cent each way from the summit. The difference in elevation of the inlets would be overcome in the gutter leading from the lower inlet in just 50 ft. At this distance up the slope the gutter would be exactly level with the upper inlet and the summit would be halfway from this point to the upper inlet, or 50 ft. from the upper and 100 ft. from the lower inlet.



TO FIND LOCATION AND ELEVATION OF GUTTER SUMMITS

CALCULATION

The paving engineers in the Board of Local Improvements for several years have been using a simple and rapid method of determining the location of summits when making the detailed design of a pavement in preparation of the profile. The accompanying sketch shows the elevation of a gutter adjoining a curb between two catchbasins. Let the top of the curb be represented by the line *CD* and the two inlets at the basins by *A* and *B*, which differ a known distance *H* in elevation. Let *AE* and *BE* represent the gutter sloping both ways from the summit *E*, whose location is desired. Let x be the distance from *E* to the higher inlet and *L* the distance between inlets. Then $L - x$ represents the distance from *E* to *B*. Then let s be the slope of the gutters in per cent, and from the sketch we obtain equation $sx = s\,(L - x) - H$. Since s is in per cent or hundredths of a foot, let *H* also be taken in hundredths of a foot. The equation becomes $sx = sL - sx - H$, or $2sx = sL - H$, and $x = (sL - H)\,/2s$. Now since it is customary here to use a slope of 0.5 per cent, the denominator, $2s$, becomes 1 per cent and $x = 0.5L - H$ or $L/2 - H$.

Applying this formula to the previous example, $x = (sL - H)/2s = (0.4 \times 150 - 20)\ 0.8 = 50$ ft. For this slope the formula gives no shorter method than the one first described. It is when a slope of 0.5 per cent is used that the method is shortened. In the latter case the method merely involves the work of dividing the horizontal distance between inlets into two equal parts, and subtracting the vertical distance between the inlets in hundredths of feet from this half distance to obtain the distance from the summit to the upper inlet.

The sum of the distances *K*, which is sx, and *N*, the length x, multiplied by the longitudinal slope of the top of the curbs, when subtracted from the height of the curb at *A*, gives the depth of curb y at the summit *E*. Of course the summit must come below the top of the curb and is seldom made less than 3 in. below it. The desired depth below the top of the curb can be obtained by altering the depths *AC* or *BD* of the inlets, by varying the distance *L* between catchbasins or by using a different slope, s, in the gutters. When the various distances or dimensions are decided upon they are marked in their relative positions upon the profile.

PRAIRIE-LIKE EFFECT IN CROWN

Theoretically the crown of most pavements laid by the Board of Local Improvements is to be at curb grade, but, except on car-track streets, where it meets the tracks, it usually undulates up and down along the street from summits to inlets. If the crown were uniform these undulations would be parallel to the gutters. This would seriously mar the appearance of the street and would be more or less objectionable for traffic. The long lines that contribute so much to the beauty of the street are obtained to a certain extent, in spite of the breaks in the gutters, by decreasing the crown from the inlets to the summits. This gives the finished pavement a sweeping longitudinal curvature, or a sort of modified prairie-like effect that is pleasing to the eye and relieves the monotonous appearance of a pavement with a uniform crown and uniform height of curb. At the same time the choppy sawtooth effect is avoided if the proper combination of dimensions has been used in the design. One common combination of crowns used by the engineers of this department is that of 6 in. at the summits and 9 in. at the inlets for an asphalt pavement with a 30-ft. roadway.

CONCRETE IN CURBS MADE BY HAND

Two general types of curb are used. Sandstone for new curbing is obtained chiefly from the Berea district in Ohio. Until the last few years a 5 x 30-in. hand-dressed sandstone curb supported on stone blocking was in general use, but of late years this has been displaced by a machine-dressed sandstone curb, 7 x 18 in. in size, supported on concrete chairs or cradles. The 7 x 18-in. curb is now being superseded by a 6 x 18-in. curb with the exception of streets on a heavy fill. In such cases a greater depth is provided, according to circumstances. The concrete support consists of a 6-in. layer of concrete mixed in the ratio of 1:3:6, 2 ft. in length, placed below the curb at each joint. A layer of the same length and thickness extends up 1 ft. at the back of the curb. The two layers are built monolithic. This method of supporting the stones at the joints gives a very stable curb and eliminates much of the trouble encountered with the old method from the curb getting out of alignment.

Concrete curbing may be of the vertical type or of the combined curb-and-gutter type. The vertical concrete curb is 7 in. thick at the top and 9 in. at the base, with a depth of 24 in. It rests on a bed of sand or cinders 6 in. thick. It is usually made of crushed granite and granite screenings mixed with Portland cement in proportions of 1:2:4. The exposed surface receives a ½-in. finish coat of mortar made of 2 parts of Portland cement mixed with 3 parts of granite screenings. A gravel and torpedo sand is sometimes specified instead of granite concrete, but in such cases the finish coat is the same as where granite is used in the body of the curb.

Concrete for curbs and curb and gutter is mixed by hand. The contractors in Chicago have not yet found an economical system of machine mixing for this type of work. The principal difficulties of machine mixing on curb work are the relatively small volume of concrete required for the distance covered and the necessity of having a very stiff or firm dry mix for the concrete forming the vertical portion of the curb. It is necessary for the concrete in the vertical part of the curb and gutter to be very firm so that as soon as the concrete takes its initial set the face strip may be removed and the finish or plaster coat applied.

GRADING WITH MACHINERY

In grading a street the earth is usually excavated with pick and shovel and hauled away to dumps in wagons. On certain streets where conditions were favorable, small steam shovels of the Thew type have been used very successfully. The curve of the subgrade surface is determined with the aid of three strips of wood all equal in length, called "tees." Two of these are used for sighting across the roadway from one to another; the third is placed at any desired intermediate point, usually the half or quarter points, and the corresponding difference in elevation measured off on the tee and sighted in line. A stake is then set at this grade.

FILLERS AND JOINTS

Pitch filler for brick is most commonly used in Chicago, chiefly because of its greater convenience and economy. Asphaltic filler is also used extensively, ranking next to pitch. It is more expensive than pitch and requires more care in its application. Cement grout filler is not used very extensively for brick pavements built by the Board of Local Improvements. It has long been recognized as an excellent filler, but it is essential that the traffic be excluded from the pavement for several days after the grout has been applied.

Joints in the granite-block pavements are first filled with hot dry roofing gravel, which is thrown upon the surface and swept into the joints. The blocks are then rammed with an ordinary 75-lb. rammer, after which the joints are completely filled with a hot coal-tar paving pitch. Immediately after applying the pitch and while it is still hot the surface is dressed with a ¼-in. course of hot roofing gravel.

Both asphalt and pitch, if an excess is applied, tend to aggravate the annoyance caused by the exuding of the creosote oil from wood paving blocks. In an endeavor to eliminate the annoyance caused by this "bleeding" of the blocks, sand and cement grout fillers have been used. The sand is applied hot and is swept into the joints until they are completely filled. Cement grout, when used for a filler, is mixed in boxes, then poured upon the surface of the pavement and swept into the joints. It requires several days, however, to set sufficiently to permit traffic upon the street, and any movement of the blocks due to expansion shatters the bond of the cement so that the joints are not sealed. Neither sand nor cement grout seems to make any perceptible reduction in the bleeding of the blocks, and when they do bleed the annoyance is not appreciably less than on pavements with a pitch filler, where it has been properly applied. Therefore they are not being used very extensively at present, as the pitch filler seals the joints completely and seems to give as good results otherwise as sand or grout.

Creosoted wood-block pavements generally have a foundation of 6 in. of concrete, but in the "loop" district an 8-in. concrete foundation is common. On the foundation is placed a 1-in. sand cushion or a ½-in. mortar cushion, which is shaped as the cushion for a brick pavement. The mortar cushion is always provided near the brow along a street-car line to prevent the churning of the sand cushion up through the joints of the pavement. This churning is caused by the pounding of the heavy cars over the rails.

In former years various angles of laying have been used, such as 45 deg. and 68 deg. from the center line. It was found, however, that a 90-deg. angle gave as good service as the others and eliminated the difficulty of making miter joints in the blocks at the ends of the courses. Expansion joints are provided along the gutters approximately 1½ in. in width. No transverse expansion joints are provided. It was formerly customary to provide ¼-in. transverse joints every 25 ft., ½-in. joints every 50 ft., or 1-in. joints every 100 ft. On the theory that these joints presented lines of weakness across the pavement they were omitted and expansion joints provided at the sides only. The results obtained were very satisfactory and no more trouble was encountered from expansion than if the transverse joints had been provided. Consequently they have been eliminated.

CONCRETE PAVEMENTS IN ALLEYS

Mixtures in one-course concrete pavements have recently been changed to 1:2:3 proportions and the requirements for the coming year have been broadened to permit the use of either torpedo-sand or limestone screenings and either gravel, crushed limestone or slag in mixing the concrete. The optional use of the different materials named allows for full competition and will probably result in more economical construction, thus compensating for the increased cost of the richer mixture. The concrete is not reinforced, as a general rule. This form of pavement, one course, 1:2:4 cement, sand and gravel concrete, has been built in alleys for two years now and appears to give satisfaction. Several cracks have developed, but no serious defects have been found. Since they have been in service such a short period of time no statement could be made as to their maintenance requirements or durability.

Expansion joints are placed about 35 ft. apart in all concrete pavements. Either steel plates are anchored in the concrete on each side of the joint or the pavement is made of a rich granite concrete for a distance of 6 in. on each side of the joint.

Framed Concrete Engine Bed

A FRAMED reinforced-concrete engine bed embodying several novel features is now in use at Rockford, Ill. The frame is 11 ft. 6 in. wide at the base and 6 ft. 10 in. at the floor line. Monolithic with the frame are two reinforced-concrete engine beds 5 ft. 4 in. long, 24 in. wide and 20 in. high. The rods holding the engine to the bed were not bedded in the concrete; iron pipes were cast in the concrete, leaving openings through the bed proper, through which the bolts were passed after the engine was placed. Heavy washers were placed on the lower end to make a better bearing for the lower nuts. Both ends of the bolts were threaded.

A platform 6 in. thick was placed 6 ft. above the basement floor, which served the double purpose of providing a convenient place on which to work while placing the bolts and acting as a stiffener to the columns and preventing torsion due to the action of the double 50-hp engine. Although the frame carries a double 50-hp engine, scarcely any perceptible vibration has been noted under a full load.

The structure was designed for the Rockford Paper Mill by Charles C. Stowell, consulting engineer, of Rockford, Ill.

DUTIES OF STEAM-DRIVEN centrifugal pumps at the St. Louis Chain of Rocks low-service station, reported in the latest annual report of the water commissioner, indicate that the pumps exceeded specifications in each case. No. 4 under 61.83-ft. head pumped 36,544,000 gal., developing 102,060,000 ft.-lb. per 1000 lb. of dry steam. Corresponding figures for No. 5 were 58.86 ft. head, 38,480,000 gal. and 104,100,000 ft.-lb. per 1000 lb. of steam.

Low Bidder Forfeits Surety

Proposal to Release Contractor Who Erred in His Bid and to Return Certified Check for $10,000 Eventually Overruled in Case at Cleveland, Ohio

WHEN bids were opened for the construction of the Brooklyn-Brighton Bridge in Cleveland, Ohio, it was found that T. P. McCourt, of Akron, Ohio, was low at $438,811—more than $100,000 less than the three other bidders. After the bids had been tabulated Mr. McCourt, in a letter addressed to the Board of County Commissioners, which was authorized to let contracts, stated that an error had been made in his bid in that an item which he intended to allow for removal of plant and for contingencies depending upon the labor situation had been omitted, and he therefore requested that his bid be not considered.

An examination of Mr. McCourt's bid, however, indicated an error of judgment rather than a clerical error. It was recognized that he could not possibly construct the bridge at that price and because of the mistake in judgment the commissioners were reluctant to keep his certified security check of $10,000.

INSTRUCTIONS TO BIDDERS

However, the instructions to bidders and the information on the proposal sheet relative to the retaining of the certified check clearly covered the situation. It was also realized that the building of the bridge was a public undertaking, with the conditions clearly stipulated on the blank, which thus formed a part of the contract. When appealed to, the county solicitor, in a written opinion, held that the board could do only one of two things—reject all bids or award the contract to the lowest bidder, reawarding the contract and retaining the surety if after ten days he failed to undertake the contract.

It was evidently adjudged best not to follow the first of these courses, for the second plan was adopted. The unfortunate low bidder aided matters by waiving his right to wait ten days before signing the contract and at once authorized the commissioners to enter into the contract with the next bidder.

This information was furnished by W. A. Stinchcomb, county engineer of Cuyahoga County, in which Cleveland is located.

FIRE-INSURANCE REQUIREMENTS with particular reference to fire prevention, as summarized in a small pamphlet issued by the New York Chapter of the American Institute of Architects and the New York Board of Fire Underwriters, comprise six important considerations, as follows: (1) Shutters, doors and skylights, outside sprinklers and fire hydrants, to reduce exposure to fire from without; (2) construction of the building to resist for four hours a temperature of 2000 deg. Fahr.; (3) design of building with limited height and suitable fire stops, lightning protection, wire glass, gravity tanks and proper electric wiring; (4) fire-extinguishing equipment; (5) consideration of nature of occupancy, character of contents and class of work, and proper installation of dangerous machines; (6) public fire protection, which depends on the efficiency of municipal fire, water, and building departments.

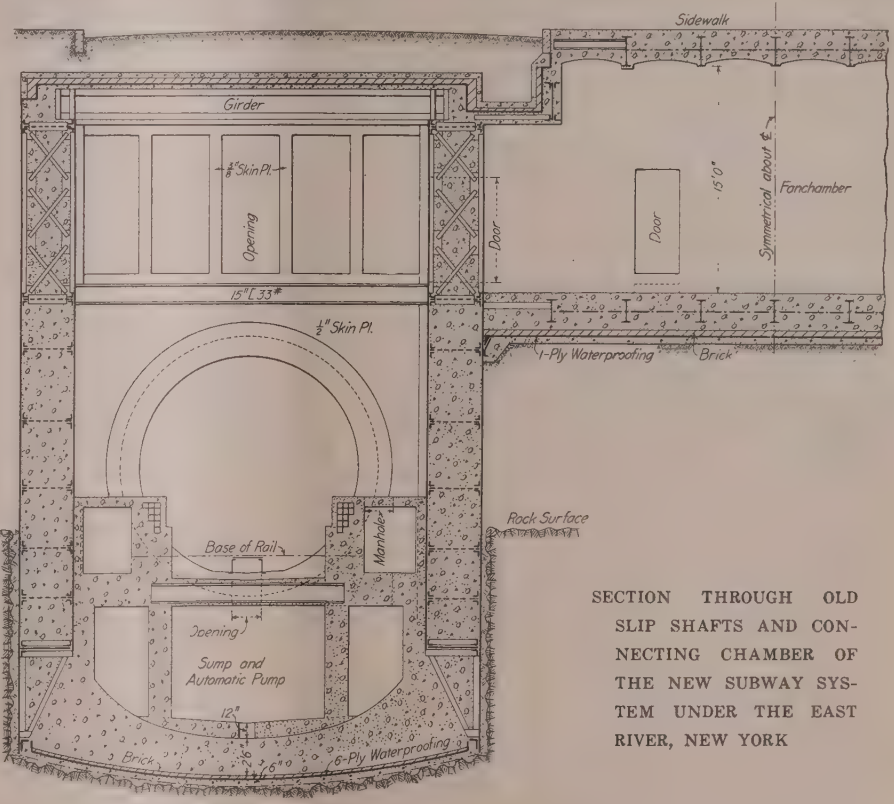
Old Slip Tunnel, New York City

Features of Section of New Subway System under East River Connecting William Street, Manhattan, with Clark Street, Brooklyn

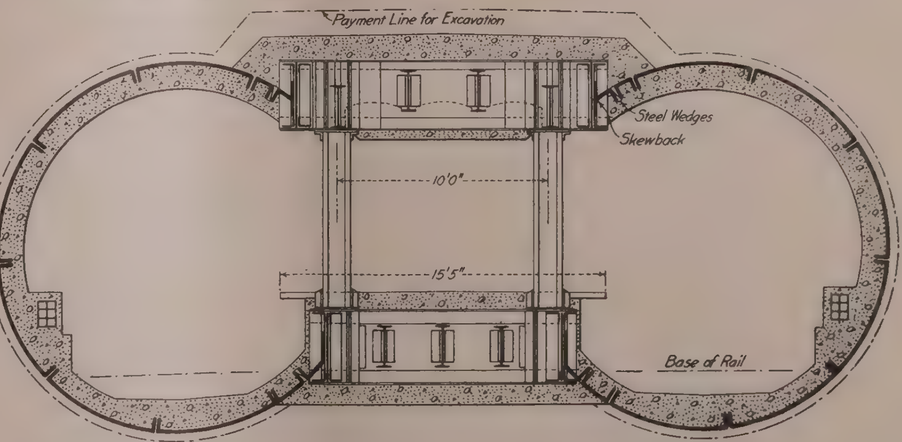
CONTRACT Section 3 of Route 48 for the Rapid Transit Railroad, New York City, includes the construction of the East River tunnel of the Park Place, William Street and Clark Street line. It differs from other work of similar character included in the subway system chiefly in the character of its shafts, in the location of the tubes at Old Slip, in the design and construction of the station at Clark and Henry Streets and on account of the difficult requirements for tunneling very near the surface of the ground.

This section is 5900 ft. long and has two single-track cast-iron tubes lined with concrete and constructed by the pneumatic-shield method and one double and two single shafts with double steel walls filled with concrete and sunk by the pneumatic-caisson process. The section includes the station at the Brooklyn end for the reason that it seemed advisable to build the latter by the shield method, and it is expected that the next adjacent section of subway structure may be executed in open trench, so that it was desirable to have the station built by the plant installed for the tunnel construction. Except for differences involved in the shafts and by the station construction, the general design and method of executing the work are the same as for the Whitehall Street tunnel, which was described in the Engineering Record of July 25, page 92, and conform in general to those heretofore used for similar structures in this vicinity, with modifications and improvements developed for the conditions here governing.

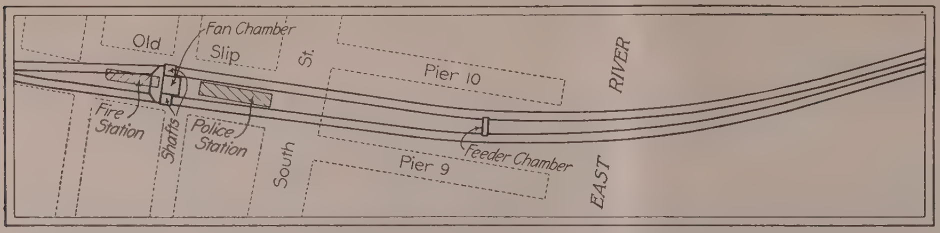
The Old Slip tunnel is 3799 ft. long between shaft centers and 1950 ft. long between pierheads. It has a total of 11,800 lin. ft. of single track and its base of rail is at a maximum depth of 86.5 ft. below mean high water, with a maximum depth of 65 ft. of water in the river. The construction involves estimated quantities of about 125,000 yd. of tunnel excavation,



SECTION THROUGH OLD SLIP SHAFTS AND CONNECTING CHAMBER OF THE NEW SUBWAY SYSTEM UNDER THE EAST RIVER, NEW YORK



TRANSVERSE SECTION OF HENRY STREET STATION AT BROOKLYN END



LOCATION OF SHAFTS AND FIRE AND POLICE STATIONS AT MANHATTAN END

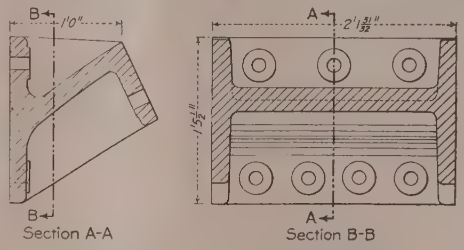
27,000 yd. of other excavation, 35,200 yd. of concrete and 36,150 tons of cast-iron tunnel lining. Only two weights of cast-iron lining, of the same external diameter—17 ft. 6 in.—are used, because the tunnel is expected to be shield-driven its entire length. The heavy lining to be used in soft ground has 9-in. flanges and weighs 6200 lb. per linear foot; the light lining to be used in rock has 7-in. flanges and weighs 3960 lb. per linear foot.

At Old Slip the tunnel tubes are separated to clear the foundations of an engine house and police station and are curved to long radii to reunite under the river. This arrangement necessitates the construction at Old Slip of two single shafts, the upper ends of which are connected by a subterranean chamber in which ventilating fans are installed. The other shaft, at Clark Street, is a double shaft divided by a partition into two chambers serving the two tunnel tubes.

TUNNEL STATION

The station at Henry Street is about 600 ft. long, with an entrance located on private property west of Henry Street and a full-length platform 15½ ft. wide between the tracks. The heavy floor and roof are both built with longitudinal beams connected to transverse girders with heavy columns at both ends. The ends of the transverse girders are also connected by longitudinal plate girders intersecting the tunnel-lining ring and forming top and bottom fascia for the openings from the tunnels to the platforms. All of the girders are embedded in a heavy mass of concrete and the construction serves as a connection and brace between the segments of tunnel-lining tubes. The tunnel-ring sections which intersect the fascia girders are made special, with their curved webs integral with vertical extensions, making oblique T-shape pieces bearing against the webs of the fascia girders. After the completion of the tunnel tubes it is expected to break out over their tops and excavate between them for the station construction.

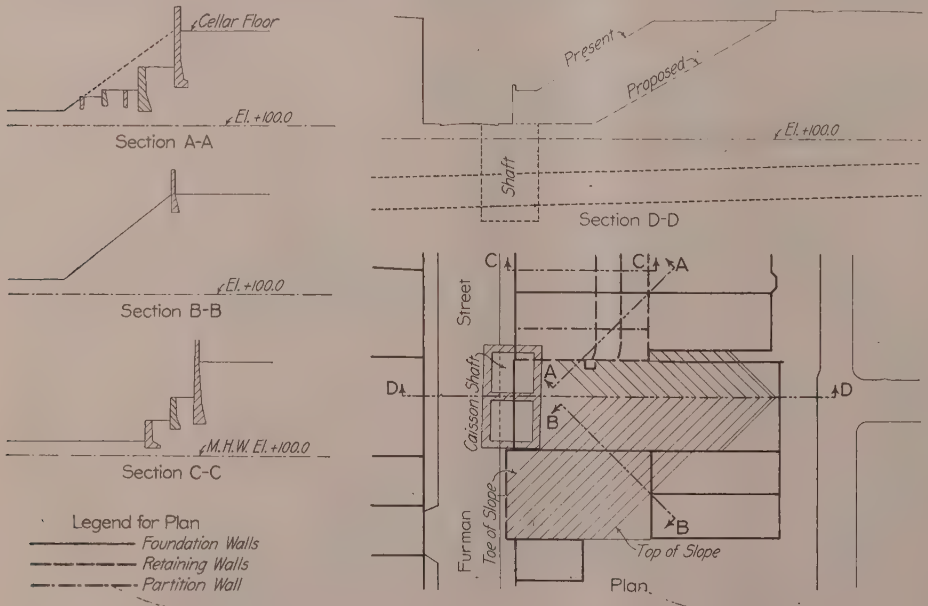
The Clark Street shaft intersects the toe of a retained steep slope of unstable earth, and in order to prevent the heavy unbalanced thrust which this would exert on one side of the shaft caisson provision is made for removing the surcharge by temporary excavation in planes at right angles to each other and oblique to the center longitudinal line of the shaft. After the construction is finished this excavation will be backfilled, restoring the surface of the ground to its original appearance.



DETAIL OF STATION SKEWBACK

At a point near the Brooklyn bulkhead line a depression in the bottom of the river brings the surface there to about the same elevation as the top of the tunnel, and it will be necessary, before tunneling operations reach this point, to fill in the bottom to a considerable depth, as permitted by the Secretary of War, in order to enable the work to be safely conducted.

The work has been designed and its execution will be directed by the New York Public Service Commission, First District, of which Alfred Craven is chief engineer and Frederick C. Noble, division engineer.



PLAN AND SECTIONS OF TEMPORARY EXCAVATION AT CLARK STREET SHAFT

Irrigation in America and Victoria

Factors That Have Made for Success in Australia and Lessons to Be Learned from Our Own Experience

As is well known to those interested in irrigation matters, the State of Victoria, Australia, has gone into extensive irrigation development, the work being under the direction of Elwood Mead, a well known American engineer, now chairman of the State Rivers and Water Supply Commission. The distinctive feature by which Victorian development methods differ from our own lies in the financial assistance given the settler by the State, funds being loaned him for the development of his property, as outlined in Mr. Mead's discussion at the Denver Irrigation Conference, an abstract of which was printed in the Engineering Record of June 13, 1914, page 668.

Upon returning to Australia Mr. Mead submitted to the Minister of Water Supply a report on his observations here. It reviews conditions generally well known in the United States, but also summarizes briefly the Victorian conditions and points out the lesson which Victoria can learn from the experience of the United States Government. These portions, because of their interest, are reprinted below.

REASONS FOR SUCCESS IN VICTORIA

There has been some criticism of the State's policy in accepting settlers with small capital, but those who have had most to do with this development are certain that the course pursued was the only one which would have led to any substantial results. If all applicants with less than $2500 capital had been rejected, as some have advised, the closer settlements of Merbein, Rochester and Shepparton would not exist to-day, for not one applicant in ten had this sum. Such a policy would have lost to these districts some of their most successful settlers. The commission has not believed it was justified in denying any applicant an opportunity, if it was believed he had a reasonable prospect of success. It is not alone in this view. In conversation with the manager of the conservation department of the Canadian Pacific Railway, who has charge of the settlement of its irrigated land, he said when asked what capital was insisted upon: "If the settler looks right we give him a trial, almost regardless of capital. We have to take some risks, if we are to complete our development in a reasonable time."

It has also been demonstrated that the aid which this State gives makes capital of less importance than adaptability, persistence and industry. Men with $5000 but lacking these essentials have failed; on the other hand, men who had to borrow the money with which to pay their deposit have succeeded. Although not one settler in ten knew how to grade land or apply water to crops, and still fewer had any knowledge of the combination or rotation of crops suited to the branch of agriculture they wished to follow, about two-thirds are now either assured of success or have good prospects.

EXTENT OF SETTLEMENT

These results have created a confidence in irrigation that did not exist before. Land values are rising, and the State is now offering irrigated land for much less than has to be paid for privately owned land adjoining. There are to-day 180 settlers established at Merbein, where there were none five years ago. There are 150 families on the irrigated part of Cornelia Creek estate, which four years ago was a sheep pasture, with no one living on the irrigated portion, and was largely infested with thistles and rabbits. The revenues of the commission have risen from about $440,000 the first year of its existence to $950,000 for the present year.

This progress has not been secured without some loss to the State or disappointment to individuals. On the human side, it was menaced at the outset by divided authority and control, one authority providing the land and the other the water. At first the scheme attracted from abroad a large percentage of visionary and impractical settlers who looked on the land, the house and the graded fields, which the State provided, as an endowment, and apparently expected continued contributions to their support. It has not always been possible to avert losses to the State where either undeserving or unfortunate settlers failed. Some of the contributory causes have been seepage troubles at Cohuna, rabbits and thistles at Koyuga, and difficulty in irrigating some of the land exhausted of humus by long-continued wheat growing. These losses are insignificant, however, when compared to the increase in income from water, the immense gain in population and products, and improved social conditions. Of the 119,000 acres acquired by the State for closer settlement in the irrigated areas, 100,000 are now subdivided and 74,000 are settled. Channels are being built to water the remaining 19,000, which will be available in a few months. When it is occupied all the water of the State works will be allotted.

LESSONS TO BE LEARNED FROM AMERICAN EXPERIENCE

Discussing the stagnation in American irrigation, Mr. Mead's report says:

The problem before the Federal Government and the managers of the bankrupt private companies is to find a way out. Some of the arid States are assisting the private companies by taking over the works and developing them as State enterprises, the condition being in one instance that the indebtedness shall be scaled down so that the cost of water shall not exceed $40 an acre. It is difficult to see how anything short of State aid will save the private schemes from wholesale bankruptcy. The Federal Government has attempted to relieve its settlers of their difficulties by amending the Reclamation Act so as to give 20 years' time to pay for the works. After the initial deposit no further payments are required for the first six years, and no interest is charged at any time. If interest is taken at 5 per cent this amounts to practically giving the works to settlers, while if interest is taken at the rate which the Government pays for the money it borrows for building these works it amounts to a donation of many millions of pounds. I heard no criticism of the Government's action. It was generally believed that the public benefits from having the land made productive justified it. It is not, however, a wise economic measure, because it assists the speculator, and does *not* give the settler the assistance he most needs. Fully one-half of the land under the Government works is held by non-resident speculators, and this act enables them to retain it without any improvements or payments for six years. What the settler most needs is money with which to grade and seed his land and build a house and barn. Until he has these improvements he cannot pay for the works, even if the time is made 50 years.

The financial troubles of American irrigation development have their origin in two mistakes:

1. Construction of works outran the demand for irrigation by those able to pay.
2. Failure to extend aid to men of small capital in overcoming initial obstacles.

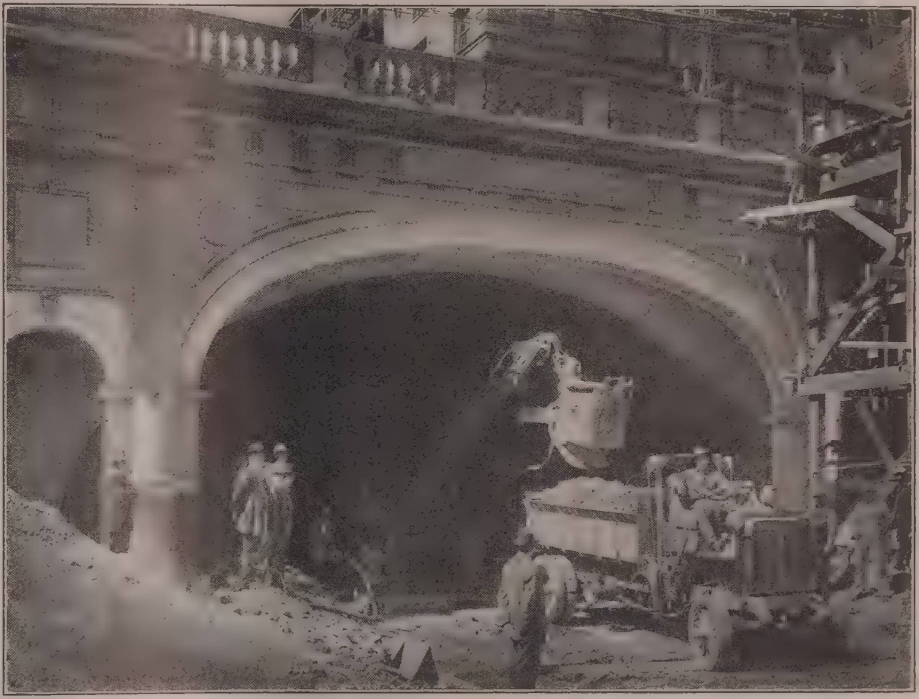
To avert in the future the first of these mistakes in this country [Victoria] all plans for new works should fix the location where water is to be used, and the maximum and minimum limits of acreage cost. The landowners of the proposed irrigation area should be consulted as to whether they are willing to have the water allotted and pay the compulsory charge on the terms outlined. If they are, or a majority are, then irrigation development will be freed from all financial risks as far as the State is concerned; if they are not, or if opinion is adverse, then the price at which the State can buy land for subdivision should be ascertained, and if this is low enough to insure its ready sale under closer settlement conditions, then development is warranted. In the latter case, however, the estimates should include the sums needed to buy land and give financial aid to settlers. If these arrangements cannot be made in advance, then construction should be deferred until there is a greater demand for irrigation.

Unless these precautions are taken, the losses incurred under American works and the fundamental mistake of early Victorian development will be repeated. The need for these precautions is greater in Victoria, because irrigation is not a matter of necessity, but of choice. It is not needed to enable men to live on the land, but displaces one kind of agriculture for another, supporting more population and giving larger returns. It, therefore, encounters more opposition, and is less highly valued than in regions wholly arid, where it is a necessity to human existence.

Removing Core of Stockton Street Tunnel, San Francisco

Steam Shovel Excavates 15,000 Cubic Yards under Arch with Clear Span of 50 Feet and Rise of Only 16 Feet

THE concrete lining of the Stockton Street municipal tunnel in San Francisco was completed on June 25, and on July 17 a steam shovel began removing the central core, which was about 36 ft. wide, 14 ft. high and contained 15,000 cu. yd. of material. The accompanying photograph, which shows the shovel served by a 4-cu. yd. auto truck at the south portal of the tunnel, also illustrates the broad flat curve of the arch, which has a clear span of 50 ft. with a rise from springing line to crown of only 16 ft.



STEAM SHOVEL WORKING UNDER UNUSUALLY WIDE FLAT ARCH OF STOCKTON STREET TUNNEL

All of the 14,000 cu. yd. of concrete used in lining the tunnel was placed by the pneumatic method, the mix being conveyed in the 8-in. pipe line for a maximum distance of about 950 ft. on some parts of the work. As the core was removed and the arch was exposed to easy examination, it was found that although there had been no tamping or other handling of the concrete as it was delivered into the forms under pressure, the surface is uniformly smooth and free from air pockets. The mix used was 1:2¼:5. The interior is to be finished by roughing the concrete and applying a coating of white Medusa cement.

Owing to the flat curve of the arch it was not feasible to elevate the sidewalks in the tunnel so as to provide a space beneath for conduits. On the other hand, the material encountered in driving the tunnel developed heavy pressures and made it undesirable to excavate below the sidewalk and alongside the foundation for conduits. It has therefore been decided that no rights to lay wires or mains through the tunnel will be granted to public-utility corporations.

Six Months at Dayton under City-Manager Plan

General Surveys Being Made for Large Future Expenditures When the Studies Are Completed and the Money Is Available

NOTHING startling has developed in Dayton during the last six months under the new city-manager form of government, but municipal business is now transacted in an expeditious way and the usual hangers-on around a city hall are absent. The city is living within its income and all service possible is being extracted from equipment on hand. H. M. Waite, city manager, in a recent interview with a representative of this journal, stated that no construction of magnitude was under way as yet, because the time necessary for making a full survey of the field had not been sufficient. Furthermore, money is not available, and a rule has been laid down that contracts cannot be let unless the money has no other claim against it.

Several large undertakings are being studied in detail. The water-supply and distribution systems, both entirely inadequate, have been under investigation for a number of months by Pollard & Ellms, consulting engineers, of Cincinnati. Temporary expedients in the way of additional booster pumps and the raising of pressures 10 lb. at the station have not given proportional relief all over town, as the distribution system is full of inconsistencies, such as 8-in. pipes feeding long lines of 12-in. and a single 10-in. river crossing where the city supposed it had a 16-in. and an 8-in. Rush work on the ground-water supply at Tates Hill has already provided more water than can be pumped, but the distribution system must be enlarged to carry it. As fast as data are obtained the general scheme is perfected and contracts will be let.

GARBAGE DISPOSAL

Another problem in Dayton is the disposal of garbage and refuse. Hering & Gregory, consulting engineers, of New York City, have drawn plans for a disposal plant and have made the necessary estimates. A bond issue must be voted before anything can be done, but it is a question whether the city's finances will stand an immediate $300,000 issue on top of a number of other more needed improvements.

Regular weekly garbage collections all over the city have been established, whereas in the past certain portions had two or three collections and others none. Lack of funds has required simple rules as to bringing cans to the alley and placing only garbage in the cans. Rubbish and ashes collections, discontinued last year, have been renewed. After cleaning the alleys it required a number of collections to take away the accumulations in cellars and back yards which householders seemed to discover for weeks. Monthly service only can be rendered with the funds available, but the service is uniform over the city.

Paving heretofore has been repaired by bond issues. A strict ruling against this financial procedure has been made. Where asphalt streets were in an impassable condition and needed repaving tar-macadam "one-year" patches are being applied. A comprehensive plan has been outlined. Main arteries and through routes will be paved first from end to end.

Twenty districts for oiling gravel streets have been created. One-half gallon in two applications is placed on thoroughly clean streets to avoid "tracking." Although Mr. Waite has, with the exception of the board of education, every activity of the city under his control—from the regulation of loan sharks through the law department to the running of an amusement park through the division of parks and the regulation of vice and the police through the department of public safety—other things initiated of interest to the engineer are plans now under way for the general elimination of grade crossings, a draft of a new building code to be ready Jan. 1, 1915, a city-planning board to report on a program for city development and a civic center; the design of a comprehensive storm and sanitary sewer system with which all new construction will accord, the publication of a park-system plan prepared some years ago, the purchase of dumps in accordance with the plan, and the working of short-term prisoners in parks, at the garbage dump and in the city garden.

Possible Railway Routes Through the Rockies

Review of the Topographical Features of British Columbia That Controlled the Recent Railroad Locations

SELECTION of the routes through British Columbia for the Canadian Northern and the Grand Trunk Pacific Railways has been attended by the collection of a great deal of detailed information in the past few years as to the general topography of all that portion of the Province lying south of the fifty-sixth parallel of latitude. This has made it possible to sum up effectively the chief topographical features of the region in the light of railroad development. This has been done by J. V. Nimmo, division engineer of the Canadian Northern Pacific Railroad, in a paper read before the Canadian Society of Civil Engineers, from which what follows has been taken.

It may be considered that a railroad traversing British Columbia in a general east-and-west direction has to thread through two main mountain systems. One of these consists of the Rocky Mountain and middle-range systems and the other comprises the Coast Range. Between these two groups lies the belt of the interior plateaus. A striking feature of the first group is that it is subdivided by a number of great depressions running approximately northwest and making a small angle with the main axis of the mountain ranges. The greatest of these depressions is a narrow trough extending for a distance of 990 mi. from Flathead Lake in Montana to the Yukon boundary. This trough has been named the "Rocky Mountain trench." A second trough, 220 mi. long, which cleaves the southwestern wall of the first near Beavermouth, runs southward and is occupied for 74 mi. by Kootenay Lake. This trough separates the Purcell Range on the east from the Selkirk Range on the west and is called the Purcell trench. A third depression, known as the Selkirk Valley, extends southward from near the fifty-second parallel of latitude through a wide valley about 300 mi. long to the Columbia lava fields of Washington.

Between the fifty-fourth and fifty-sixth parallels the western wall of the Rocky Mountain trench is much less prominent than it is either to the south or north, and between these two parallels the interior plateaus might be said to extend right up to the trench. The various ranges to the west of this main trench and south of the fifty-second parallel concentrate into one north of the Selkirk Valley. This single range attains its narrowest width and lowest pass at Albreda Summit, almost opposite Yellowhead Pass.

PASSES AND COAST CONNECTIONS

Between the fifty-sixth parallel of latitude and the international boundary there are seven main passes through the Rocky Mountain chain, as follows: Crow's Nest, El. 4449 ft.; Kicking Horse, El. 5270 ft.; Howse, El. 4500 ft.; Athabasca, El. 5710 ft.; Yellowhead, El. 3718 ft.; Smoky River, El. 5400 ft., and Pine, El. 2850 ft.

The Crow's Nest and Kicking Horse passes, taken by the Canadian Pacific Railway, cross the mountain chains in their widest parts and lead to routes which cut directly across the great trenches and pass over high intervening summits. From these two passes there is only one feasible route for crossing the Cascade and Coast Ranges, namely, the Fraser River Valley, and to reach this a circuitous route and heavy gradients are necessitated.

The Howse offers no suitable approach from the east and leads to the same difficulties as the Kicking Horse. The Athabasca and the Smoky are too high, and the approaches from both sides are too steep to admit of easy grades. The Pine is good, but the geographical location puts it at a disadvantage as compared with the Yellowhead, which permits of easy approach from east and west and gives access to easy passes through the Cascades that lead to first-class deep-water harbors.

Examining the outlets to the coast it is found that the main routes are by way of the Fraser River and Burrard Inlet, the Nomathco River to Butte Inlet, the Bella Coola River to the North Bentinck Arm, the Salmon River to Gardiner Inlet and the Skeena River to Prince Rupert. Of these only the first and last are routes that connect with the major breaches in the Cascade Range, and the only ones that do not offer gradients somewhere in their course which would be a serious obstacle to transcontinental traffic.

Both the Skeena and Fraser River routes lead to breaks in the Cascades, which connect by very easy grades with Yellowhead Pass. Thus, instead of being obstacles, as in the case of the route adopted by the Canadian Pacific Railway, the great trenches are utilized in the recently located northern routes to secure easy gradients from the prairies to the sea. The Grand Trunk Pacific line west of Yellowhead Pass follows the Rocky Mountain trench until its western wall ends, whence there is an easy route westward across the great interior plateau via the Nechako and Bulkley Rivers. The Canadian Northern Pacific line west of Yellowhead Pass crosses Albreda Summit and thus gains the Thompson River, a tributary of the Fraser.

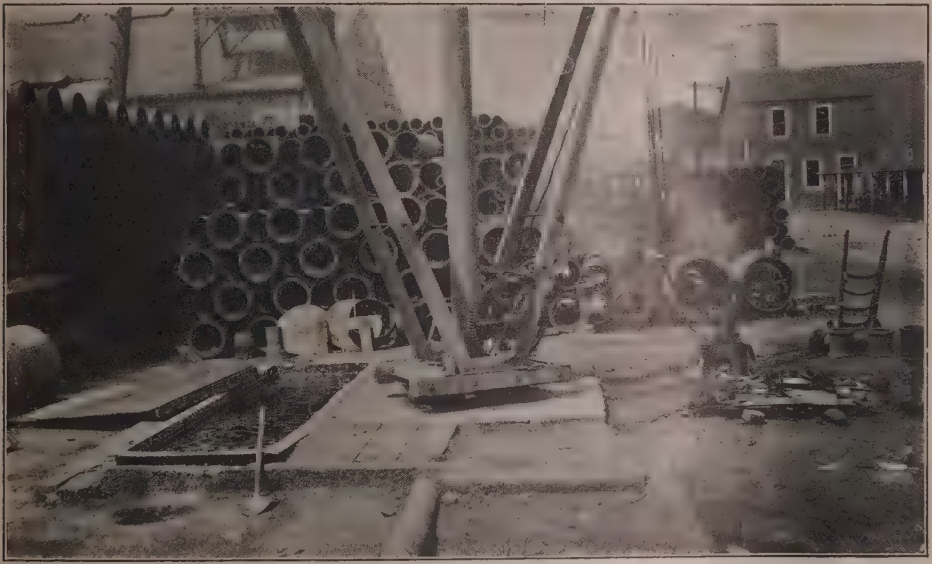
The advantages of following the great trenches are shown by the relative maximum gradients on the three roads, which are as follows: Canadian Northern Pacific, 0.7 per cent; Grand Trunk Pacific, 1.0 per cent, and Canadian Pacific, 2.2 per cent. It is also to be noted that the two first-named roads began operations over the grades named, while on the Canadian Pacific Railway a maximum grade of 4.2 per cent obtained for more than twenty years until large sums could be afforded.

Hot Pipe Dipped in Cold Tar

To Effect Economies San Francisco Method Reverses Usual Order of Immersion in Heated Bath by Warming Pipe Over Wood Fire

SEVERAL methods of arranging the plant for applying tar coating to cast-iron pipe were tried out by the Spring Valley Water Company in San Francisco, and it was finally decided that any method which required keeping hot a tank of the preparation to be applied was not economical. The system now employed has been in use about fourteen years and involves heating the pipes and castings over a wood fire and dipping them while hot into a vat containing 1 part asphalt and 6 parts coal tar. The bath is not heated in any way.

The accompanying view shows the dipping plant with a vat 14 ft. x 3 ft. 7 in. in plan and 3 ft. deep. The lengths of pipe to be dipped are rolled along the skid pipes, whose ends show in the foreground of the picture, and which span a depression in the ground in which a fire is built. The pipes to be dipped are kept over the fire until the right temperature is attained, when they are rolled further along to a point beneath the boom of the dipping crane. Small castings and short lengths of pipe are heated, as shown in the picture, over a fire immediately beneath the crane.



TANK FILLED WITH COLD TAR IN WHICH HOT PIPE IS DIPPED

A heavier and more perfect coating is secured by dipping hot pipe in cold tar, it is claimed, than by immersing the cold metal in a heated bath. In addition to saving the time lost in heating up the bath for treating by the old method, especially when small jobs have to be put through, it is pointed out that a hot pipe will take a coating in a cold bath much quicker than if it were dipped cold in a hot bath, so that when the pipe instead of the bath is heated the actual dipping can be done more rapidly. Even when a large quantity of pipe is to be treated, the method of heating the pipe before dipping is preferable because the metal can be warmed more quickly by direct heat from the fire than through the medium of a hot bath, which is continually cooled to some extent by repeatedly dipping in cold metal. When the pipe is dipped hot, the coating dries about as quickly as the pipe cools, so it is ready for handling very soon after treatment.

The method of heating the pipe instead of the bath makes it possible to turn out in a given time more work, with a better coating and at a less cost, it is claimed, and there is the additional advantage of having the coating dried quickly by the heat radiated from the cooling metal. The method would not be practicable for steel pipe, of course, but all cast-iron pipe, specials, fittings, hangers and, in fact, everything that goes into the system below ground or along the wharves, are first heated and dipped. The result of continuing this practice for many years has been so effective that a recent expert examination of the distribution system developed the fact that it was in much better shape than other systems of equal age.

Rolled Iron and Steel in 1913

FIGURES for the production in the United States during 1913 of finished rolled iron and steel, including merchant bars, concrete reinforcing bars, skelp, nail plate, etc., have been issued recently by the American Iron and Steel Institute. The production of iron and steel merchant bars in 1913 amounted to 3,957,609 tons, against 3,697,114 tons in 1912, an increase of 260,495 tons, or more than 7 per cent. Of the total in 1913 about 1,026,632 tons were iron, against about 944,790 tons in 1912, a gain of 81,842 tons, and about 2,930,977 tons were steel, against about 2,752,324 tons in 1912, a gain of 178,653 tons.

In 1913 there were 149 plants in 24 States which rolled iron or steel merchant bars, as compared with 146 plants in 23 States in 1912. In 1913 iron merchant bars were rolled by 79 works in 23 States and steel merchant bars by 96 works in 18 States, while in 1912 iron merchant bars were rolled by 80 works in 22 States and steel merchant bars by 96 works in 17 States.

In 1913 the production of iron and steel bars for reinforced concrete work amounted to 319,670 tons, as compared with 274,332 tons in 1912, an increase of 45,338 tons, or over 16.5 per cent. Of the total in 1913 about 113 tons were iron, as compared with about 2500 tons in 1912, and about 319,557 tons were steel, as compared with about 271,832 tons in 1912.

In 1913 there were 38 plants in 16 States which rolled reinforcement bars.

Salem Conflagration

Summary of the Causes Which in Many Other Cities Threaten a Repetition of This Disaster

A GRAPHIC word picture of the causes and effects of the conflagration at Salem, Mass., June 25 and 26, 1914, has been painted by Franklin H. Wentworth, secretary of the National Fire Protection Association, in a bulletin issued by that organization. While the story of what happened at Salem is now quite well known, Mr. Wentworth's presentation is so striking as to warrant widespread reading. The first part, therefore—the summary—is reprinted below. In addition certain excerpts are given from a report of the Factory Mutual Companies. Readers are referred for data as to water pressure and supply to the report by F. F. Longley in the Engineering Record of July 25, 1914, page 98.

The summary, forming the introduction of Mr. Wentworth's paper, is as follows:

EFFECT OF DISASTER NATIONAL IN SCOPE

Salem, Mass., famed in American history, exhibits her scarred and blackened face to her sister cities asking for alms with which to feed her children while she draws together with characteristic American good temper the broken threads of her crippled existence. And the sister cities respond with open purse, masking with their generosity their sly and silent consciousness of equal culpability, of equal niggardliness in protection of their common life, of equal complacency in the midst of dangers known but yet unrealized—Dorchester, Roxbury, Somerville, Everett, Cambridge, Lynn, Boston herself, with conflagration possibilities, values considered, probably greater than any other equal area in the world.

Sixteen hundred buildings in thirteen hours; two hundred and fifty-three acres of desolate ruins; fourteen millions of dollars of value in the work of men's hands—that is the first cost of Salem's disaster. Over $11,700,000 of this is to be replaced involuntarily by the American people. This vast sum, spread over the continent through fire-insurance premiums as a tax upon clothing, shoes, hats and food, must make the struggle of life harder for millions of Americans who thus contribute to rebuild a city which without their sacrifices could not cover its nakedness in half a century.

Salem has put her hand in every American pocket to collect the cost of a devastation and ruin she might easily have avoided. With the example of Chelsea glaringly before her she could not plead ignorance—she knew her danger and she had ample time in which to modify it. She assumed no responsibility to protect the lives and livelihood of her common people, and her property-owning class was content to run its daily risk because it knew it could saddle its fire losses upon the country.

Forty-five thousand people in a wooden city, with roofs of tinder, with a municipal water system that would shatter at a pressure of 60 lb. and a starvation fire department defeated at the outset by a fire from a cause the commonest inspection precautions would have eliminated—that is an exhibit before which unlimited censure is restrained only by charity for human weakness.

Salem was of wood, and there is enough of it left for another conflagration. From the small cottage with its plot of ground to the crowded three and four deckers housing the mill workers she had her stage admirably set for the thing that happened. Wooden factory buildings without individual fire protection were strategically located to feed the fire where it needed such encouragement.

It was a slow-burning conflagration; the wind was light. If it had not been for this the business district also, with its unprotected window openings, would have been snuffed out along with the factories and dwellings. Federal Street (which still has the fuel for it) would have led the fire to the city's heart. The devastation would have been complete.

Water

Water from hose streams never yet stopped nor extinguished a conflagration. Conflagrations are stopped only by physical barriers, otherwise they burn themselves clear. The Atlantic Ocean stopped this one. The water thrown at Salem was over 10,000,000 gal. Perhaps 10 per cent. of it was effective—in harassing the conflagration along its northern edges and in preventing it from taking a back track into the mercantile district at Derby Street, where a few open spaces helped by the South River reduced the area of superheated air and enabled the engine companies to make a stand at a point where the wind was not against them. Water was effective in preventing the second fire in North Salem from reaching conflagration proportions.

The cement-lined water mains did not burst until after the fire had spent its force, but the constant fear of their known weakness paralyzed all effort to use water except by the steamers supplying their own pressure. The abundant water supplies of Peabody, Danvers and Beverly were gingerly tied into the Salem system in fear that the pressure they had to contribute would shatter Salem's obsolete old mains and end the water-throwing for good. The result of this necessary caution is shown in the pressure table accompanying this report. The water supplies of four cities contributed a combined hydrant pressure of from 10 to 20 lb. With water enough to raft Salem out to sea her citizens on the borders of the fire zone threw away their garden hose and extinguished the sparks on their shingle roofs with tree-spraying outfits.

The usual diverting American comedy of fire engines from neighboring cities unable to couple their drafting lines to the hydrants because of non-standard, non-uniform hose couplings and hydrant fittings was not lacking. Boston, Lawrence and Beverly have the Lowry flush hydrant and their companies brought with their engines the chucks necessary to use them. The companies from other towns and cities spent their time in looking for spare outlets on chucks already in use, or in preserving their engines from destruction. Horse-drawn apparatus was about half as mobile in dodging as the motor apparatus, and the steam engines exhausted their fuel and took to burning fences and box boards, while the gasoline-consuming apparatus had fuel reserves and threw their water steadily at the heat.

Fire Department

Modern fire departments are agencies of conservation. They make inspections and remove the causes of fire. The Salem fire department is not modern. The Salem conflagration should never have spread beyond the Korn factory [where it started]. A few thousand dollars spent there for automatic fire protection would have saved fourteen millions.

If the chief of the Salem department knew that hazardous processes were conducted in an unprotected wooden factory in a conflagration district he should have forbidden it. If he did not know it Salem's confidence in him as the guardian of her safety was misplaced. If he had no authority to forbid it he should have publicly told the Salem people of their danger. Modern fire departments extinguish unnecessary fires with intelligence—before they occur. That the Salem, and the twenty-one companies of visiting, firemen worked hard and bravely no one will gainsay; no criticism is directed at them. The work and the courage demanded by this conflagration were needed higher up before it started. A commissioner of public safety, or a fire commissioner, or a fire chief, with modern ideas of responsibility and service, would have located the hazard which started this fire and eliminated or safeguarded it.

The Warning

The shortcomings emphasized are not set down to shame Salem. They are assembled as a warning to other cities which are equally culpable. They show the futility, the impotence, of fire departments and fire department apparatus with a sweeping fire under way. They demand attention to three cardinal needs of the modern city:

1. Improved building construction, with especial regard to sweeping fires. The entire abolition of the shingle roof within *city limits.* (It is futile to exclude the wooden shingle from congested fire limits merely and allow its use on surrounding acres of wooden dwellings.)

2. A modern and reliable water supply under adequate pressure, and well distributed post hydrants with standard connections common to all neighboring cities.

3. Proper municipal housekeeping under the administration of a commissioner or fire chief possessing modern ideas with authority to maintain cleanliness, regulate the storage and use of inflammables, and compel the proper automatic fire protection of all buildings endangering the public safety.

Following his own report, not here reproduced, Mr. Wentworth quotes in full the report of the Associated Factory Mutual Fire Insurance Companies on the destruction of the Naumkeag mills, the greatest single loss of the conflagration. The following portion of this report in particular is worth the careful consideration of industrial engineers. It is as follows:

Destruction of Naumkeag Mills

The only buildings in the entire plant [of more than twenty buildings] that escaped destruction were No. 10 Storehouse and No. 1 Storehouse. The former building originally was a gasometer, has joisted roof covered with asbestos roof covering, noncombustible cornice and brick walls. These had but two openings protected by double fire doors. Very likely, owing to the fact that they were double, fire did not enter, as the outer door was somewhat warped. It is a low building, and although the platform around it was burned it probably was rather sheltered, and in this way escaped destruction. It contained 1,300 to 1,500 bales of cotton, which is undamaged.

Number 1 Storehouse is of reinforced concrete construction, walls, roof and floors. There are some small wired glass windows in metal sash, mostly fixed, which are protected in addition by wood tin-clad shutters on the inside of the building, hinged at the top and swinging vertically, and these were held open normally by fusible links. These links all melted and allowed the shutters to close. Two stories of this building contained finished goods in cases, but, although the building was exposed to the full force of the conflagration on the west side, so completely did the window protection do its work, and so well did the concrete walls stand up against the flame, that fire did not enter the building. Not a sprinkler opened, and the contents are intact. The damage to the building is so slight as to be almost negligible, and while the wired glass windows in several cases suffered so much heat that they softened and bulged out at places, and in one case completely melted out, yet the interior shutters withstood the attack, and did not allow the fire to enter the building.

Protection Toward Point of Attack

The Naumkeag property stood on a point of land bounded on three sides by Salem Harbor. During the early years of its development the land on the fourth side was vacant, or sparsely settled. Gradually this territory became covered with wooden buildings; and this fact had been appreciated but it was felt that the protective equipment available could safeguard the mill.

The chief lesson is that to defend a property successfully against a conflagration all buildings must be fire resistant toward the point of attack. There should also be a liberal water supply at good pressure, and ample equipment to bring the water to any point. It should be remembered that when a conflagration is raging the public fire department will probably be unable to give assistance, so that the protected property is likely to be thrown on its own resources.

The tremendous power of an advancing conflagration with the fire-brands, flame, smoke and heat carried before it will overcome anything except the best construction protected with reliable apparatus and defended by courageous men, disciplined to do good team work.

Pig-Iron Output Decreases

COMPARING the figures issued recently by the bureau of statistics of the American Iron and Steel Institute the pig-iron production in the United States in the first six months of 1914 was 23.9 per cent less than for the corresponding period of 1913. In the first half of 1914 the output was 12,536,094 gross tons, against 14,477,550 tons in the last half of 1913 and 16,488,602 tons in the first half of 1913. The country's maximum production of pig-iron in any two half-yearly periods was reached in the twelve months from July 1, 1912, to June 30, 1913, when the output amounted to 32,143,265 tons. The output in the first six months of 1914 was the smallest in any half year since the last half of 1911.

PAVEMENT CUTS for trenches in Springfield, Ohio, are repaired by cutting the old material back 12 in. from the edge of the trench so that the pavement joint is not directly over the side of the trench. Backfilled material is tamped by hand in 6-in. layers. For all waterworks trenches a Staley tamping machine is used.

Economic Aspects of Intermittent Sand Filters

Statistics from Many Cities Indicate Superiority of Sprinkling Filters from Standpoint of First and Operating Costs

THERE appeared in this journal on Aug. 1, 1914, page 117, a comment on the proposed abandonment of the intermittent sand filters for treating the sewage of New Britain, Conn. Both by inference and direct statement the point was made that this type of sewage treatment is more economical than the "intensive treatment plant," meaning thereby Imhoff tanks and sprinkling filters. Incidentally, success for the intermittent sand filters at Worcester was claimed as evidence that this type of filtration warranted a great deal of attention. Believing these statements to be erroneous, a correspondent has directed the attention of the Engineering Record to certain data on the subject. They are here given in order that the misconception evidenced by the editorial comment may be removed.

In the report of the Massachusetts State Board of Health for 1903 the average cost of intermittent sand filters in nine Massachusetts cities—Andover, Brockton, Clinton, Framingham, Gardner (old), Gardner (new), Pittsfield, Stockbridge and Worcester—is given as $3260 per acre, which figures out to a cost of $3.50 per capita connected to the filters. In 1906 the Baltimore Sewerage Commission estimated that the cost per acre of filters would be $6350, these filters, with the sewage first subjected to sedimentation, being suitable for a connected population of 1200 per acre, corresponding to a per-capita cost of $5.30.

SPRINKLING FILTERS

For sprinkling filters, on the other hand, based on the data afforded by the plants at Atlanta, Reading, Columbus, Baltimore, Montclair, Philadelphia, Pittsburgh and Mt. Vernon, the first cost for filters 7 ft. deep is estimated at about $45,000 per acre. On the basis of a loading of 19,000 people per acre of filter the cost per capita is $2.30.

One item in the data given for intermittent sand filters is worthy of special note. The Baltimore estimate of the per-capita cost for treating settled sewage is considerably above the actual corresponding cost of sand filters in Massachusetts, where the sewage at most plants is seldom settled to any extent. This is due to the unusually favorable conditions for the construction of sand filters in Massachusetts, conditions that do not represent the average throughout the country. In many, if not most, places the cost would approximate more nearly that estimated for Baltimore. These figures indicate, therefore, that as to first cost sprinkling filters are a far more economical installation than intermittent sand filters.

Incidentally, estimates on contact beds are of interest. In a recent estimate, made with considerable data in hand, it was concluded that a 4-ft. bed equipped with suitable appurtenances would cost about $30,000 per acre. With a loading of 5000 people per acre the per-capita cost would be $6.

OPERATING COSTS

As to operating costs, data published in the annual report of the superintendent of sewers of Worcester are of interest. The conditions there approximate quite closely those at New Britain, the sewage at both places containing high percentages of iron from the pickling wastes of industrial plants. Worcester has been making experiments for more than two years on Imhoff tanks and sprinkling filters. The conclusion, as given in the annual report of the superintendent for the year ended Nov. 30, 1912, is that "the cost of operation of Imhoff tanks and sprinkling filters per 1,000,000 gal. of sewage treated would be very much less than the cost of chemical precipitation or sand filtration as carried on at Worcester."

In the report of the superintendent for the year ended Nov. 30, 1913, the cost of operation of the intermittent sand filters for the year is given as $13.82 per 1,000,000 gal., a figure which includes the expense of relaying underdrains, the cost of which if deducted would bring the net for operation down to $7.75 per 1,000,000 gal. In this connection the following quotations from the report are also interesting:

"It seems essential to the successful operation of the sand filters that a sufficient sum of money be appropriated to provide for relaying the underdrains of about one-fifth of the filter beds each year. In this way the maximum efficiency can be obtained for the expenditure of a reasonable sum of money."

"The cost of sand filtration includes the expense of relaying the underdrains in 21 beds—a total amount of $8,557.30 or $407.49 per acre."

The intermittent sand filters at Worcester receive sewage which first has passed through a grit chamber and a settling tank holding about one-half hour's flow. Such filters at Clinton receive sewage which has been settled for nearly two days, as judged by the capacity of the tanks in reference to the average daily pumpage. The reports of the Metropolitan Water and Sewerage Board show that the cost of maintaining the latter filters was, for each of the years 1912 and 1913, $10.80 per 1,000,000 gal. furnished.

Compared with these results the figures for operating the sprinkling filters at Columbus in 1912 are $2.62 per 1,000,000 gal., and for 1913, $2.40. The costs at Reading, while not available, are known to be in the neighborhood of $2.

In view of these figures the statements as to the success of intermittent sand filters when compared with sprinkling filters appear not to be justified, for both the first and operating costs of the latter are materially lower.

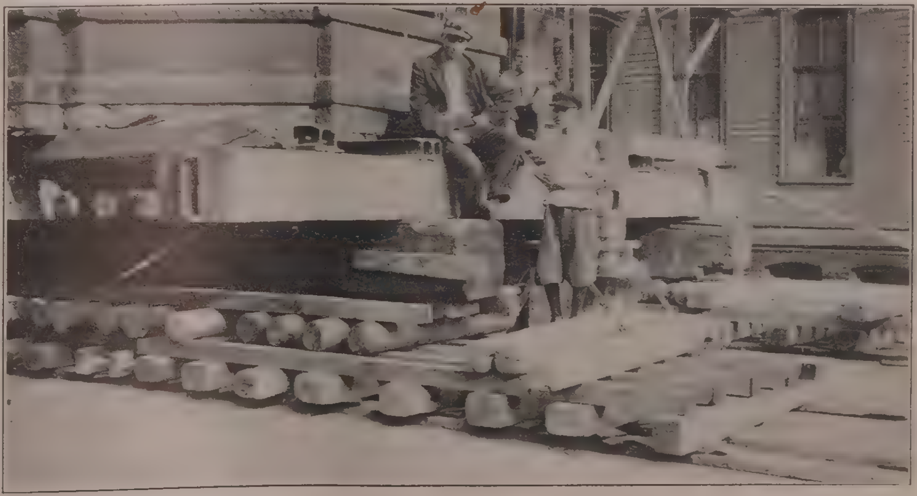
Moving Four-Story Building 2500 Feet through City Streets

Eleven Men Place 570-Ton Chicago Residence in New Location in Three Months by Means of Timber Raft and Rollers

A FOUR-STORY brick residence in Chicago, of 570 tons, has been moved about 2500 ft. by placing it on a raft of timbers, rolling it off its stone foundation, hauling it through four streets and across a street-car track, and turning it around four corners. The building stood at 1004 Townsend Street and was moved east to a location on the west side of Sedgwick Street near Locust Street.

MOVING 570-TON BUILDING

The scheme of shoring used in moving the building is shown in one of the photographs. The building is 70 ft. high, 22 ft. wide and 68 ft. long. Sixty days were spent in loading the building. The hitch by which the building was pulled consisted of two four-sheave pulleys, which were connected by cable to a drum. Three chains were run around two 18 x 18-in. longitudinal carrying girders 72 ft. long, one



METHOD OF SHORING AND TIMBER RAFT ON WHICH BUILDING RESTED near the front of the building, one at the center, and one in the rear. Fastened to these chains were pulleys connected to the two four-sheave pulleys and also to a drum in the rear.

It took eleven men three months to move the house. A straight run of 700 ft. was made in four days. When the building was turned around a corner a stake was set as a pivoting point and all the rollers under the building pointed toward that point. It took eleven men two days to make a turn.

The asphalt streets which the building traversed were protected by 3 x 12-in. planking and were not injured in the slightest degree. The building was moved by J. P. Kwiatkoski, a building mover of Chicago.

"Clean-Up Week" in Philadelphia

Methods of Conducting Widespread Campaign to Improve Sanitary Conditions in City by Enlisting Aid of Citizens

BY enlisting the aid of its citizens through an extensive campaign of publicity Philadelphia succeeded in collecting and disposing of 135,000 cu. yd. of waste material during its "Clean-Up Week," from April 20 to 25. The work was undertaken to improve the sanitary conditions in the city and reduce the fire hazard. The following information regarding the methods employed has been received from R. Robinson Barrett, chief inspector of nuisances of the Bureau of Health.

A committee of three men, representing the bureaus of highways, fire, and health, was appointed by the Mayor to take charge of the work done under the supervision of the city officers. The members of this committee were John Neeson, assistant engineer of bridges and sewers, Bureau of Highways; Joseph Mallory, fire marshal, and R. Robinson Barrett, chief inspector of nuisances, Bureau of Health.

Shortly after the appointment of this committee the Chamber of Commerce and the Merchants' and Manufacturers' Association of Philadelphia appointed a large representative committee of citizens to cooperate with the city committee in conducting a successful campaign. This committee was divided into twelve subcommittees—finance, press, poster and printed matter, trade associations, community associations, charitable and benevolent, school and school children, churches, retail stores, street cars, vacant lots and fire prevention. Persons on this citizens' committee are all prominent business men and men interested in civic activity in Philadelphia.

ADVERTISING

In order that every citizen might know the date and the object of "Clean-Up Week," and in order that they might give their best co-operation, an extensive and effective advertising campaign was entered into. The director of the Department of Public Works sent out 3400 personal communications to the following: All advertisers and advertising agencies, manufacturers of brushes, brooms, buckets, vacuum cleaners, and, in fact, to every concern manufacturing any kind of an article used for cleaning; all women civic organizations—Civic Club, Home and School League, literary, etc.; business men's organizations, theater managers, managers of moving-picture houses, real-estate agents, banks and trust companies and boards of trade.

Two large placards announcing clean-up week were posted on the windows in each street car operated in the city. The same placard was distributed to schools, libraries, clubs, lodges, commercial and industrial establishments and railroad companies, with the request that they be posted in a prominent place.

Seven hundred and fifty thousand gummed labels suitable for attaching to envelopes and to packages carried through the mail and delivered by the department stores were distributed to all public-service corporations, department stores, newspapers, banks and trust companies. These gummed labels were very attractive and were found to be a most effective means of advertising.

Two hundred and sixty thousand four-page bulletins were distributed by the police at as many homes. These bulletins were not simply thrown on the porch but were handed to each householder. The bulletin was so designed that the back could be used to notify the city-waste collectors wherever there was rubbish to be moved. This bulletin contained many suggestions and means by which the citizens might cooperate with the city officials.

Twenty thousand colored display placards were distributed to the department stores and all retail merchants. These were posted in a prominent place in all of the large show windows. A much larger poster, but similar in design, was posted on all the bill boards in Philadelphia. Many of these same posters were used on hauling wagons and automobile trucks.

Seven hundred and fifty streamers, 2 x 3 ft., with the words "Clean-Up Week, April 20 to 25," were given to the industrial and commercial institutions and were used extensively on the harness of horses of delivery wagons, and in some instances were tacked on the side of the wagons. Some of these were plain white with black lettering and others yellow with blue lettering.

One million yellow cardboard folders were printed and distributed to all retail dealers, union headquarters, lodges, clubs, social centers, public-service corporations, department stores, etc., with the request that they be sent out in packages delivered and in all envelopes containing monthly statements. Three hundred thousand badges and an equal number of blotters containing information regarding Clean-Up Week were distributed to the public and parochial schools.

Three hundred and fifty thousand circulars were distributed to the policyholders of the Metropolitan Life Insurance Company.

"MOVIES" AID CAMPAIGN

Several colored slides, indicative of the spirit of Clean-Up Week, and containing information regarding same, were made up and sent to the moving-picture theaters, of which there are 205 in the city. It is estimated that 700,000 people attend moving-picture performances daily, and there is no doubt that this was one of our most effective means of advertising.

Programs, leaflets, circulars, etc., were used by the theaters and moving-picture houses. A number of the commercial interests in the city took advantage of the spirit of Clean-Up Week and advertised their wares and commodities useful for Clean-Up Week.

Bulletins of various organizations throughout the city, such as the City Club, Civic Club, Business Men's Association, etc., devoted a great deal of space to Clean-Up Week. Many of these organizations prepared letters and circulars of their own which they distributed among their members.

Return postal cards were sent to the owners of all insanitary vacant lots urging them to clean and beautify their properties. More than six hundred of these cards were sent out.

In addition, a very extensive newspaper campaign was carried on, which reached its climax in the issues of Sunday, April 19, immediately prior to Clean-Up Week. Articles by prominent men from all walks of life, commending the Clean-Up Week spirit, were printed in all the morning papers.

Clergymen, in addressing their congregations on Sunday, April 19, requested the co-operation of their parishioners in their endeavor to make Philadelphia "spick and span."

Many neighborhood contests were instituted and prizes were offered to the boys and girls doing the best work during Clean-Up Week. Garden contests were encouraged and the use of vacant lots for garden purposes was heartily endorsed by the combined committees.

Many addresses and lectures were given by members of the Clean-Up Week committee and city officials, instructing the citizens of the advantage to be gained through Clean-Up Week.

COLLECTION OF WASTE

In all the advertising matter which was displayed the householders were advised of the fact that the city would remove all the waste accumulated in the grand cleaning up. They were advised that this material would be collected on the days of the regular ash and waste collections. Arrangements were made with all the contractors collecting waste and ashes in Philadelphia to put on many hundred additional teams to take care of the excess material during this week. Special teams were arranged for to remove material where it was accumulated on vacant lots. All ofthe municipal buildings were given a thorough cleaning and all the offices and desks of the employees were cleaned out. A great number of department stores, public-service corporations, etc., also issued orders to their employees along the same line.

The city painted most of the fire plugs during this week and the United Gas Improvement Company repainted its lampposts. Wherever it was impossible to secure the co-operation of the property owners in cleaning up vacant lots the division of sanitation of the Bureau of Health issued mandatory orders upon the owners. If these orders were not complied with the work was done by the city and the properties liened in accordance with the Acts of Assembly. Arrangements were made for extra dumps in all parts of the city to take care of the excess material temporarily. The material collected on these temporary dumps was subsequently removed to the city's authorized disposal stations.

Of course, the whole campaign depended on the co-operation of the citizens, it being their duty to clean out their own premises thoroughly and put the waste material at a place readily accessible to the city waste and ash collector for removal. The response of the citizens to the call issued for their co-operation during Clean-Up Week exceeded all expectations. There seemed to be no particular class distinction between the persons co-operating with the city in its campaign. In every locality tremendous amounts of waste and rubbish were placed out for collection. More than five hundred lots were cleaned up and placed in a sanitary condition.

It is estimated that during Clean-Up Week more than 135,000 cu. yd. of waste material were collected. Although Philadelphia's clean-up weeks have not been in existence a sufficient length of time to make a perceptible effect upon the death rate and fire rate of the city, it is believed by the officials in charge of the work that if these annual institutions continue with the success they have during the past two years Philadelphia will be the cleanest, most healthful and the safest city in the United States.

Condition of Pavements in European Cities

Conclusions in Report of George W. Tillson, Who Made Investigation for Borough of Brooklyn, New York

GEORGE W. TILLSON, consulting engineer to the president of the Borough of Brooklyn, New York City, has published the report of his investigation last year of the pavements of the principal cities of Europe. Mr. Tillson was sent by the Mayor of New York as a delegate to the third International Road Congress in London and was also directed to observe street conditions there and elsewhere. The substance of his conclusions follows:

The general condition of the pavements in European city streets is better than that of the streets in America. As a rule all pavements were good for each particular kind. If the pavement was old stone block, its surface would be good, and the same was true of macadam, showing plainly the attention given to proper repairs. Of the cities visited Berlin had the best pavements, and they were kept in the best condition.

Street car tracks and the pavement in the street car area are in better condition in Europe than in America. In the larger cities the street surfaces are disturbed more on account of subsurface construction than is generally recognized in America.

As a rule obstructions and encroachments in streets do not receive as much consideration in Europe as in America, and not as much attention is given to having the street lines uniform. Sidewalks are used for restaurant purposes in all Continental cities.

The cheap pavement of Europe is macadam, and the large amount noted is especially surprising in all cities except Berlin. The officials recognize, however, that this is not a permanent pavement, and steps are being taken to replace it with permanent pavements as rapidly as possible. This is particularly true of Paris.

There are several reasons for the condition of streets being better in Europe than in America. As a rule a good new pavement in this country is practically as good as that in Europe, and the wood pavements are undoubtedly better. It must be admitted, however, that more care is taken in the construction and more attention given to details, and after the work is completed repairs are more promptly made. Practically the same materials are used for modern European pavements as in this country, but there is a feeling that the pavement, like all other construction in Europe, should be of a more durable and permanent character than is considered necessary in this country. The street car track areas are under the entire control of the city officials in almost every case, so that there is no red tape existing to prevent prompt repair and renewal when necessary.

Officials in Europe recognize the fact that openings in pavements are very detrimental, and everything possible is done to reduce these openings to a minimum. For instance, wherever possible, subsurface work is laid in the sidewalk area. Manholes are so constructed as to present as little obstruction to the street surface as possible, and property owners and corporations are notified long in advance as to when and with what materials the streets are to be paved.

European cities are generally built from the center outward, and when once built there is very little change in the buildings, so that openings, which in this country are so largely due to the erection of new and larger buildings, are much less in number than in the United States.

The people of European cities are more law-abiding than those in America and the laws and ordinances are more rigidly enforced. If a rule is made regarding pavements, it is generally considered that it is to be enforced, and the property owners govern themselves accordingly.

All work appeared to be carried on slowly; the municipalities seemed to be in no hurry. This fact undoubtedly aided in carrying out details.

The small amount of maintenance work going on was surprising.

Although specifications in all European cities are less rigid, more indefinite and capable of wider variation in work than those in this country, it must be admitted that the results were uniformly good, the contractors evidently having moral obligations to do good work.

The amount of money spent for repairs to pavements seemed in all cities except Paris to be remarkably small. This is undoubtedly due, to a certain extent, to the lower rate of wages and the lower cost of material.

Another reason possibly for the efficient work is the small units of the municipal corporations.

Letters to the Editor

Cracking of Bronzes and Brasses

SIR: The enormous proportion of expansion cracks, sometimes called season cracks, in the use of low copper tin alloys when subjected to extreme cold and heat conditions has alarmed our metallurgists, engineers and manufacturers simply for the reason that safety has been disregarded in the greed for higher tensile strength. Each new set of specifications or revision adopted, up to the first part of the year 1913, has shown a very noticeable increase in the physical requirements. (See articles in Engineering Record of Nov. 8, 1913, page 527, by Alfred D. Flinn, and April 11, 1914, page 415, by Ernst Jonson.)

The U. S. Navy was among the first to adopt specifications for the elimination of the aforesaid trouble and started an exhaustive investigation. The ultimate result was the adoption of a more reasonable specification for yellow bronzes, called naval, manganese, and by proprietory name, such as Tobin, etc.

In the use of approximately 3,000,000 lb. of yellow bronzes in the construction of New York City's Catskill aqueduct the trouble has developed only in the cold-worked material, which was not properly annealed as a final process and one that cannot be eliminated entirely when an exact dimension is required by cold-drawing or rolling other than machining.

To explain more intelligently the action of expansion crackage a billet of the following chemical properties (in per cent) was cast: Copper, 61.33; zinc, 37.66; lead, 0.16; tin, 0.83; iron, 0.02. From this billet the tests and micro-photos given below were made. The piece was then extruded to $1\frac{1}{8}$ in. diameter, round, allowed to cool slowly in the air, and a test piece taken and physically tested. An even formation of the crystals was shown. (See Plate 1 and Sample 1 in table.)

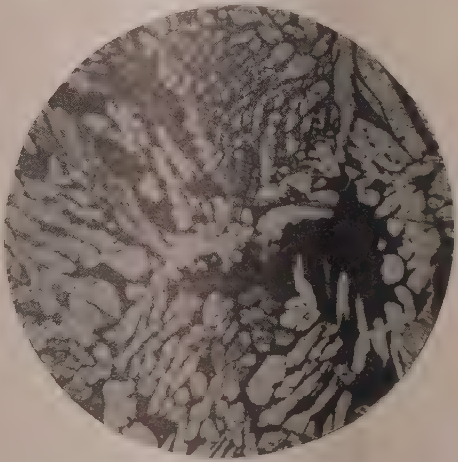


PLATE 1

Parallel to surface lengthwise; half way into center

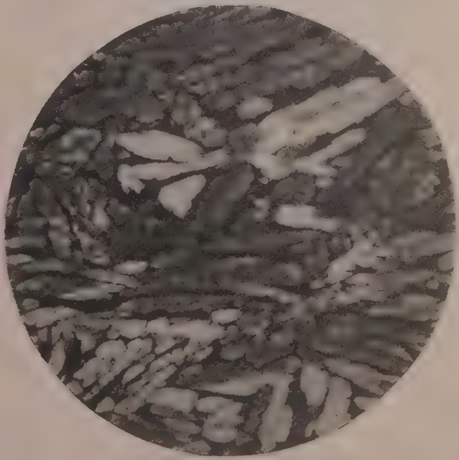


PLATE 2

Lengthwise; half way to center

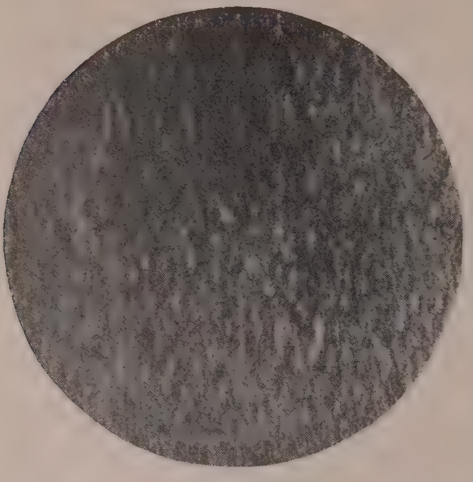


PLATE 2A
Surface; skin

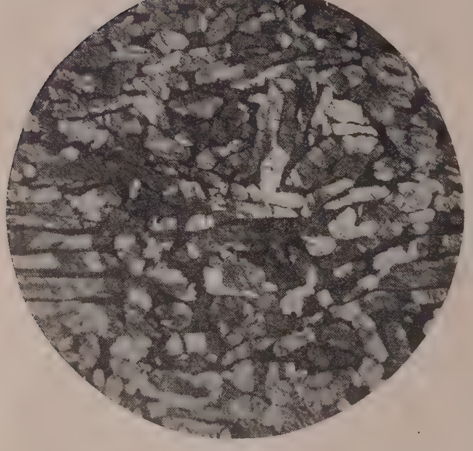


PLATE 3
Lengthwise; half way to center

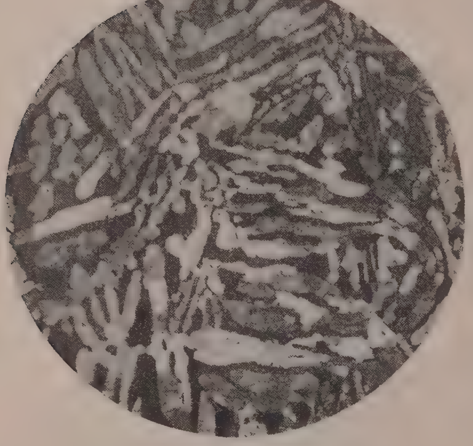


PLATE 4
Lengthwise; half way to center

Sample 2 was then taken from the same extruded rod at 1⅛ in., cold-drawn to 1 in., with the result shown in the physical table and in the micro-photo. There was an enormous increase in the tensile strength and a reduction in the elastic limit of a little over 50 per cent. This is practically the treatment of all the material which has cracked. Plate 2 (photo taken half way to center) shows the beginning of formation of uneven size crystals.

Plate 2A is for the same rod as Plate 2; the surface skin shows the crystals broken up very minutely.

Plates 2 and 2A from the same cold-drawn rod surely explain the tremendous opposition of crystals from center to outer surface skin when the action of expansion sets in. All metallurgists and metal workers will agree that the larger formed crystals will expand much more than the finer ones—hence the development through the outer skin of the rod of fine crystalline cracks, which eventually increase in size with age and exposure, working gradually toward the center.

To eliminate this and furnish an absolutely serviceable rod the method by which Sample 3 was produced is the only safe one, which will not be affected by any extreme temperature or weather conditions and for once and all will eliminate any crackage.

Plate 3 (micro-photo half way to center) shows a sample of the same rod as Plates 2 and 2A sufficiently annealed to prevent crackage of any description—annealed at 1300 deg. Fahr. 30 min., and allowed to air-cool. Note the evenness and perfect formation of crystals. The physical properties are given in the table for Sample 3.

If a greater tensile requirement is necessary a slightly different treatment is required without detriment to the rod. The following method may be used with safety: After drawing the rod from the furnace with a temperature 1300 deg. Fahr. for 30 min., quench in cold water, with the result shown in Plate 4 (physical test table Sample 4), which shows an increase in the tensile strength of about 5000 lb. per square inch.

To overcome expansion crackage it has been the universal method for years among the manufacturers to spring rods thoroughly before annealing or shipping, but this has proved insufficient to guarantee against crackage in low copper tin alloys when worked cold, and while it is still used to some extent the method and treatment of Plate 3, Sample 3, is the one that can be thoroughly depended upon. Castings and forgings sometimes develop this same ailment from different causes by uneven stresses placed upon them, shrinkage, and by working a fine crystalline surface in the methods of machining to size.

The following specifications are recommended for yellow bronze:

Chemical Requirements, Per Cent

Copper	Tin	Zinc	Iron max.	Lead max.
60-63	0.5-1.5	Rem	0.10	0.2

Physical Requirements, Per Cent

Thickness	Tensile strength	Elastic limit	Elongation in 8 in.	Elongation in 2 in.
Up to ½ in..	60,000	27,000	25	35
½ in. to 1 in.	58,000	26,000	28	40
Over 1 in....	54,000	25,000	28	40

No material less than ¼ in. in diameter is to be tested physically. This material is suitable for the following: Bolts, valve stems, studs, nuts, piston rods, propeller blades, and parts requiring strength and incorrodibility, especially if subject to corrosion of salt water.

L. D. Van Aken,
Superintendent, National Brass & Copper Tube Company.
Hastings-on-Hudson, N. Y.

Physical Test Table

Sample	Size, in.	Area, sq. in.	Broke at, lb.	Strain per sq. in. lb.	El. limit lb.	El. limit per sq. in. lb.	Elong. in 2 in.	Elong. per cent.	Area of reduced section, sq. in.	Per cent reduct.	Hardness, scleroscope
1......	875	6,013	34,870	58,000	15,960	26,550	1.15	57.5	2,445	59.5	23
2......	874	5,999	43,800	73,100	42,220	70,100	.54	27	3,287	45.2	29½ surface 53
3......	875	6,013	34,820	58,000	16,330	27,200	1.06	53	1,122	81.5	20
4......	875	6,013	38,310	63,800	17,970	29,900	.76	38	3,706	38.5	20

Does Hypochlorite Destroy the Enamel of Teeth?

Sir: Hypochlorite treatment of water supplies has been blamed for many real and imaginary grievances. Many of these have been the result of prejudice against this form of water treatment. Among other things that have been laid to hypo might be mentioned the killing of goldfish, the fading of the beautiful red color of roses, the causing of grass to die when sprinkled with hypochlorite-treated water, the bleaching of the pretty locks of women and the making unfit for coffee or tea of water treated with hypo.

A recent work on occupational diseases mentions the injurious effects of chloride of lime upon the enamel of the teeth of workers in bleaching industries and plants making chloride of lime. Hypo has been used at the Bubbly Creek filter plant since August, 1908, and is bought in carload lots of 350 and 750-lb. containers. Previous to 1908 I had had but little trouble with my teeth. Since that time I have averaged about three sessions of two or three weeks each, during each year, with my dentist. Many of the cavities are of the marginal type.

My assistant, who has been with me for more than two years, has had identically the same experience. Former assistants, while in my employ, had sessions with dentists. One of my laborers, who had never seen a dentist's chair previous to working at the Bubbly Creek filter plant, had six or seven teeth filled after about six months in this work.

I do not believe that this condition can be blamed on the air or odor that prevails here at the stock yards, which is well known. It would be interesting to learn from others engaged at plants where hypo is used in water treatment whether or not these conditions have prevailed. It is possible that many have been looking for the culprit all this time and have been investing in various mouth washes, tooth pastes and powders, whereas hypo has been the hidden danger.

C. A. Jennings,
Chicago. Consulting Engineer.

PLUGGING PAVEMENTS to see whether specifications have been adhered to is a practice followed in Baltimore. Although there is a thoroughly competent system of inspection, both at asphalt plants and at streets, the desirability of a further check was felt recently when a great many contracts were being completed. Before final payments, therefore, it has been customary to cut out carefully a plug about 2 in. square through topping and binder, which is replaced after measurements have been made. If properly done, this is, according to R. Keith Compton, chairman of the Paving Committee of Baltimore, a very simple and rapid operation. Mr. Compton states that no violations of specifications have thus far been disclosed.

European War Offers Unparalleled Opportunities for Export-Trade Extension by the United States

Engineers and Manufacturers Long Familiar with South American Conditions Tell the Procedure in Establishing an Export Business, Point Out Pitfalls to Be Avoided and Discuss the Factors Which Will Affect American Success

ACTING SECRETARY OF COMMERCE
AMBASSADOR NAON
DR. E. L. CORTHELL
ALBERT MOYER
M. A. OUDIN
FRED LAVIS

South American Trade Customs Must Be Observed

Ambassador Naon Cites Practice as to Payments, Selling Methods, Publication of Proposals and Receipt of Bills

In an interview Señor Romulo S. Naon, Argentine Ambassador to the United States and one of the A-B-C mediators in the Mexican trouble, expressed to a representative of the Engineering Record the hope that American manufacturers would respond promptly to the commercial needs of his country. As evidence of her desire to trade with us he cited the emergency foreign-exchange system which his Government had established. He warned American manufacturers, however, that South American trade customs must be studied if headway is to be made.

It is necessary, he said, for the American manufacturer to change his business methods from what is customary here when trading with a South American country. Payments at 90 or 120 days are considered as cash payments. It is almost useless to expect any inquiries from pamphlets delivered by mail. Traveling salesmen, equipped with letters of introduction and other credentials, and familiar with South American ways and manners, are necessary if goods are to be sold.

Engineers and engineering contractors should also realize that bids are generally delivered in person by a representative and not by mail, as is customary in the United States. In advertising for bids on construction work the interval of time given before opening proposals is often as long as six months, so as to enable representatives of foreign firms to forward specifications and other data to the home office and allow adequate time for the preparation of careful estimates.

Extensive commercial relations depend on good banking facilities, a fact that has been readily appreciated by the Argentine Senate and Chamber of Deputies. On Aug. 11 a law was passed empowering the Executive to receive and deposit in the Argentine Legations sealed gold from commercial and banking houses. The Treasury Department upon receipt of telegraphic advice from the legation will then issue a bond in favor of the Caja de Conversion for the amount of gold deposited. Against the delivery of this bond through the Banco de la Nacion Argentina, the Caja de Conversion will deliver to the same bank the equivalent in paper pesos, to be credited to the proper person.

The Argentine Government, Señor Naon said, has thus made foreign exchange easy. It is for Americans to supply the ships. They can enter the South American trade in force, assured that they will be most cordially received.

How to Proceed in Extending Trade to South America

M. A. Oudin Discusses the Bearing of Method of Representation, Price and Quality on the Success of Export Ventures

M. A. OUDIN, manager of the foreign department of the General Electric Company and member of the National Foreign Trade Council, in an interview with a representative of the Engineering Record declared that the opportunity before American manufacturers as a result of the curtailment of European production is one that concerns all industries.

ADVERSE FACTORS

He pointed out that while the stoppage of European supplies of all kinds is a factor favorable to a great extension of American trade, there are two adverse factors which have a very important bearing upon the magnitude of the trade that may be obtained. The first adverse factor is the financial disturbance which has existed throughout the world for over a year. This economic depression, particularly in South America, has been made much worse by the war in Europe. The second adverse factor, which is of a temporary character, is the existent dislocation of transportation facilities. It should also be remembered, Mr. Oudin added, that the purchasing power of South American countries particularly has been greatly lessened by the partial closing of European markets to their products. This undoubtful lessening of exports from South America with the result mentioned will be offset more or less by an increase in prices.

For these reasons, at least reasonable caution should be exercised in the extension of credits. However, this is a time when liberality, both at home and abroad, should be shown by bankers, manufacturers, merchants and others, and so far as possible a give-and-take policy should be followed in order that a possibly unhappy economic condition may be averted.

HOW TO TAKE ADVANTAGE OF PRESENT SITUATION

The question which naturally arises, said Mr. Oudin, is: How can the manufacturers in this country take advantage of the present situation abroad? It is a well-known fact that a very large percentage of our exports of machinery and of manufactures of a complicated character, involving a high percentage of labor, is by companies of large resources and capital. This is the strength and the weakness of our export situation. It is the strength because it means the prosecution of a foreign trade movement on a large scale, with a disregard of early discouragements and a bending of every effort toward the development of a business for later years, even at some initial cost; it is the weakness because up to this time the population of the country as a whole has not been sufficiently interested in the wonderful possibilities of this trade to try to promote it.

The large manufacturers have been the pioneers and they have already blazed the way along which the small manufacturer can follow. The small manufacturer, however, does not seem to have taken full advantage of the opportunities—not that he has been discouraged by the difficulties of obtaining a foothold in the foreign market, but perhaps because he has not realized the necessity of foreign markets for his output. With the prestige already established in many countries for American goods and with the reputation for honest dealing made by large American concerns, the path has been made easy for the introduction of the goods of the small manufacturer. Having decided that he wants a foreign market, the manufacturer is then in a fair way of learning the way by which he can acquire it.

REPRESENTATION, PRICE AND QUALITY

The essential elements in the exploitation of manufactures abroad, Mr. Oudin declared, are representation, price and quality. If the small manufacturer cannot afford to have his own office abroad he must have recourse either to agents as a medium through which his goods may be sold or to commission houses or brokers in his own country. Another method by which the small manufacturer can acquire a market is through association with other manufacturers of allied lines. The idea of export associations is a new one in this country and has not yet been adopted to any material degree.

There is no secret as to the ways and means of securing foreign business. The methods of our great competitors, the German and English, are apparent to any one who is familiar with foreign trade conditions. What America is especially weak in abroad is personal representation. The splendid machinery used by England in her foreign trade has been built up during a century. The number of English firms established throughout the world dealing exclusively in English goods is almost legion. In the last 30 years Germany has copied English methods and German firms are being established in constantly increasing numbers in every country on the globe. In almost every country the English and German colonies are far greater numerically than the American colony. What we need most abroad is American business houses. Until our small manufacturer can sell his goods through such concerns established abroad his business is bound to be more or less intermittent, for it is obvious that he cannot depend upon the permanency of an agency arrangement with a

European firm, nor can he secure the highest effectiveness from an arrangement with a native concern.

As to prices, those of American manufacturers are higher ordinarily than those of European competitors. This is due to the higher costs of labor which prevail in this country. The influence of the war will operate in the direction of overcoming that handicap because it will have a tendency to increase labor costs in Europe.

As to quality, American goods in general are superior to those of European countries, especially Germany, but they are not always sufficiently superior to overcome the differences in cost. In many lines American engineering is recognized as superior to European engineering, but this advantage is not regarded as sufficiently great in some countries to overcome differences in cost; particularly is this true in countries whose financial resources are limited and where the people are more concerned over low first cost than over future maintenance and operating expenses.

INVESTIGATIONS AS A FIRST STEP

In the beginning American manufacturers should make up their minds to spend a large amount in investigations of foreign markets. They should expect no return for the first year or two. The difficulties of the language, the different customs and different business practices, and the entire difference in racial characteristics, are not perhaps fully appreciated by those who do a little export business with Latin America, and not at all by those who have no acquaintance with the Latin-American people. It is worse than useless to send the American type of drummer to South America.

Mr. Oudin's familiarity with conditions convinces him that the present concentrated attention upon our foreign business is in itself a potential factor making for a very large foreign trade and that it must give rise to the element of permanency which has been conspicuously absent from our efforts in the past.

United States Can Dominate South American Cement Market

Albert Moyer Discusses Present Opportunity for Displacing German, English and Belgian Cements with American Product

THE Vulcanite Portland Cement Company has been selling in the South American field for about twelve years. The following views, therefore, of Albert Moyer, manager of the sales department of that company, as given to a representative of the Engineering Record, are particularly interesting:

The American manufacturer of cement has now the greatest opportunity ever afforded him to capture, dominate and retain the South American cement market. Heretofore German, English and Belgian cements have been chiefly used—the German shipments alone to the whole of South America in 1912 amounting to 5,746,000 bbl. While in normal times it is not easy to sell against the well-established European brands, the present emergency forces the countries to the South to buy from us.

American cements are not unknown in the South American states, particularly in Chile, Peru, Venezuela and Colombia. Lack of direct shipping facilities to Argentina and Brazil has prevented as rapid progress there against European competition.

Fortunately the industry in the United States is ready for the emergency, since the Eastern mills, which are chiefly concerned in the present situation, are over-equipped on the basis of the present domestic demand. While almost any price might be obtained for American cement in the present juncture, the manufacturer must bear in mind that the emergency must not be used for the exploitation of the South American customers. We should aim to stay permanently in that market, to build up a steady trade and not give our new customers an immediate reason for returning to English and German brands when the war is over. While a price higher than received recently is justified, it would be well if all cement were laid down at our seaboard at a price to give a reasonable profit, the risks, costs of doing foreign business, etc., being all considered. Such a price would enable American manufacturers to hold their own against foreign brands when they again come into the market.

MERCHANT MARINE NEEDED

But all the efforts of the American cement manufacturers can avail nothing unless we can create a merchant marine quickly, so that there will be sufficient capacity to carry our products, and unless American bankers will co-operate so that drafts will be drawn on New York instead of London or Berlin. It is useless to expect any permanent expansion in South American trade unless the proper banking facilities are provided. In the cement line the other essentials have been taken care of—a high quality cement, superior in uniformity and in all other respects to German cement, and a proper package, all Eastern and Pacific Coast mills now being equipped to manufacture barrels with reinforced heads and tongue-and-groove staves. Moreover, the price should be no higher than for foreign cement. This is possible for several reasons. Cost of production both here and abroad is probably not far apart. The lower labor cost in Europe is offset here by cheaper raw materials and the most efficient cement machinery known. Again, our Eastern and Pacific Coast mills are as near tidewater as are the German plants. In this connection it is interesting to note that the American consular service reports that the average export price of cement from the United Kingdom in 1912 was from $7.30 to $8 a ton, f.o.b.

One point especially worth mentioning is that American manufacturers should not be misled when prospective South American customers tell them of extremely low quotations they have received on European cement. These low quotations invariably are for Belgian cement, which corresponds closely to our New York State naturals.

As to details of trade development, agents who speak the language of South American countries are essential, and it is very desirable to have literature printed in the appropriate languages — Portuguese for Brazil and Spanish for the other countries. It is best, too, to have the literature prepared in South America by someone familiar with the demands of that trade.

If American manufacturers will jump into the breach now and get the active support of the bankers and an adequate merchant marine they can readily capture a 7,000,000 or 8,000,000-bbl. market, hitherto comparatively untouched by Americans.

What applies to cement applies undoubtedly with equal force to other American manufactured goods. Now is the opportunity of generations for effective work in South American trade development.

Must Grasp South American Commercial Opportunities at Once

Dr. Elmer L. Corthell Makes Plea for Immediate Action to Realize Benefits of Trade Expansion

DR. ELMER L. CORTHELL, consulting engineer, of New York, was asked by the Engineering Record to give his views as to the opportunities for American manufacturers in South America. Having had professional relations in South America since 1899, notably as engineering adviser of the Argentine Government—in which capacity he designed and built the harbor works at Buenos Aires and Rosario—and as financier and builder of the Para port works, he is qualified to speak with authority on Latin American conditions. He expressed himself as follows:

I am urging upon all with whom I come in contact the importance of seizing without delay of a day these suddenly arisen opportunities.

While Congress is discussing the vital question of registry and the flag, the chance is slipping away. The real straits in which Latin America finds itself at the present time are not well known, or at least not appreciated. The products of vital necessity to its existence it is suddenly and almost wholly deprived of, but it has no ships to go for them even if they could reach their most important supply depots, especially in Germany. The United States has no ships in which to send the goods the South American countries require. I was in Buenos Aires two years at one time, engaged by the Argentine Government on all of its commercial work, and only once saw in port a vessel flying the stars and stripes, and that was a lumber schooner. That was in 1900; and thirteen years have not much changed the conditions except to increase remarkably the tonnage of the port. Last year there were, in entrance and clearance, 14,000,000 tons of shipping, but of 5386 vessels in and out only four were from the United States and they were *sailing* vessels—no doubt carrying timber.

Argentina and Brazil have no vessels suitable for the long course to our ports. Like ourselves, they have a coastwise fleet. The Argentine Navigation Company, Ltd., of Buenos Aires, has 300 vessels of all kinds for coast and river traffic, but none of them are suited to a voyage in the open ocean, and have not tonnage enough, anyway, for the international traffic. Brazil also has the Lagé line, of perhaps twenty good but small steamers, and the Lloyd Brasilero of eighteen or twenty steamers, but only two or three of these are equal to the requirements of a distant port.

GOODS NEEDED IN SOUTH AMERICA

In the meantime—*now*, at this moment—there is an insistent inquiry from one, at least, of these governments for ships to be bought instantly. In fact, a cablegram from Rio de Janeiro states that the Brazilian financial minister has arranged to despatch four or five steamers of the Lloyd Brasilero Government line to New York with coffee from Santos and Rio and rubber from Para, thereafter to return with articles of prime necessity. There are cables now being received from various South American and West Indian countries demanding importunately that we send them what they now so imperatively need.

SPECIFIC NEEDS

Valparaiso telegraphs for implements, machinery, railway materials, metallic items for domestic and building purposes, Portland cement and all kinds of cloth, paper, starch and sugar. Rosario, 220 mi. above Buenos Aires on the Parana River, is calling for drugs, photographic supplies, crockery, glassware, ironware, galvanized wire, motors, dynamos, electric supplies, coal, paper, etc.

Buenos Aires is telegraphing for the following goods and materials of construction representing more than $1,000,000 in each case: Pig-iron machinery, prints, coal, galvanized iron, automobiles, woolens, steel rails, cotton goods, railway material of all kinds, cement, structural steel, electrical equipment, silk, rice, glass, tramway material, knit goods, copper manufactures, sanitary appliances, bolts and nuts, tin plate, bridge materials, preserved and canned goods; and the telegram winds up, "Coal short now, railroads restricting service." The same is true in Brazil, along the whole west coast—everywhere, in fact, below the Rio Grande.

OUR TRADE WITH BUENOS AIRES

Our trade with these countries, outside of importations of kerosene and gasoline, harvesting machinery and a few other specialties, is a very small proportion of their commerce with countries now at war. Note the following important features of the trade of Buenos Aires alone for 1913: Imports from Germany, $69,000,000; Belgium, $21,000,000; France, $37,000,000; Great Britain, $126,000,000; Austria, $6,000,000; United States, $60,000,000; exports to Germany, $56,000,000; Belgium, $32,000,000; France, $36,000,000; Great Britain, $116,000,000; Austria, $3,000,000; United States, $22,000,000. The total imports were $406,000,000; total exports, $466,000,000, of which trade the United States had not more than 10 per cent.

It would seem an easy job to secure now and hold at least 50 per cent of the trade, and the same may be said regarding the whole of Latin America. But it will be no easy task. The Germans, the French, the English, the Italians, the Spaniards, and the Belgians have built up their enormous trade by continued and intelligent effort. Able agents—their own men, conformity to natural and local requirements of the trade, credits where our manufacturers demand spot cash, banks to handle the financial business, where we have none, an ocean business carried on in their own bottoms, splendid steamers and an excellent service—while even our 10-per cent share of the business is carried in foreign bottoms.

PAN-AMERICAN CHAMBER OF COMMERCE

There is only one organization, in New York at least, that realizes, or at least is materially helping Latin America, and that is the Pan-American Chamber of Commerce of New York, of which I have the honor to be a founder and an adviser. It has existed only four years, but its altruistic work for the benefit of all Latin America is telling for the benefit not only of that region but for that of our own country by opening markets and engineering and contracting opportunities for our people. Its membership is widespread and important—from the Farmers Loan & Trust Company, of New York, to General Minocal, President of Cuba—and reaches many lines of endeavor, manufacture, commerce, contracting and engineering. There are more than one hundred members, who are among the most prominent gentlemen in export houses and contracting companies in this country.

"THE MOMENT" FOR THE UNITED STATES

"This is the moment for the United States. American exporters can accomplish now, literally in a few days, what they could not have done in fifty or a hundred years had not this Continental conflict showed the way. There is nothing in the way of trade that America may take to itself now that it will ever have to give back, if the American business man seizes his opportunity in the right way and deals *honestly* with the people of South America; in fact, he will not be taking trade but replacing it."

These words, which express my decided views, are from a statement of the president and manager of the Pan-American Chamber of Commerce, Julio F. Sorzano, 42 Broadway, New York.

The Engineering Record could not better serve our own manufacturers of engineering and construction materials than by advising its readers here and in South and Central America to apply to this chamber for help and advice, which will be freely given in respect to all matters of trade between North and South America.

Length of War Will Determine South American Trade Possibilities

Fred Lavis Cautions Against Too Great Optimism as Regards Increase in Exports from United States

FRED LAVIS, consulting engineer, of New York, has been interested in Latin-American conditions almost since his entry into engineering work. Cuba first attracted his attention and positions of constantly growing responsibility took him successively to Colombia, Mexico and finally to Argentina. As chief engineer of the Argentine Railway Company he had an excellent opportunity to study that country's economic conditions. His views as given to this journal are not as optimistic as the others here presented.

There is little doubt, Mr. Lavis said, that if the present war conditions in Europe persist for any considerable length of time American manufacturers will be called upon to supply the current needs of South America for such articles as they are not able to obtain from Europe. To the extent that the war prevents European manufacturers from filling orders to that extent American manufacturers will benefit. The amount depends very largely on the length of the war.

Southern South America exports about $700,000,000 or $800,000,000 worth of food products, largely cereals and meat, mostly to Europe; the United States takes possibly 15 or 20 per cent of the total. That portion of South America still needs capital for expansion and development. In the past funds have been supplied by Europe; hence nearly all supplies are bought in the European markets.

It must be borne in mind when calculating the volume of imports into South America that much of this in the past has been paid for by European borrowed capital. This will now be practically entirely curtailed, and it is useless for the United States to expect to get this business, as we have no capital to lend. In fact, we are borrowers ourselves for improvements and expansion. With the loss of European loans, also, our own expansion will be very much curtailed, and whatever increased business we do with South America will hardly offset the loss due to curtailment here.

MANUFACTURED PRODUCTS NEEDED

None of the countries of South or Central America produces any manufactured goods to speak of, as they have practically no fuel or iron ore—at any rate at points that can be used to advantage. Labor, depending on locality, is scarce or high priced or not trained in arts or manufactures. These countries, therefore, require for their current needs all kinds of manufactured metal products, railway supplies, agricultural implements, building materials, etc. They, of course, require textiles, but it is doubtful if we can supply that need. We can supply boots and shoes and many other articles of wearing apparel. These things can be paid for to the amount or value of the exports, which in all probability will continue to go to Europe, which will have continuing need of them.

It must be remembered that European manufacturers will lose the business of South America only if the war is prolonged. It seems probable that England, at least, will be able to continue manufacturing without great interruption. At the most, not more than 2 per cent of her people will be taken from their regular occupations on account of the war, and it seems reasonable to suppose that England will retain control of the sea and pay for its food supplies by exporting manufactured goods. Then, we are not going to change the habits of all South America in a minute. They can wait for quite a little while, probably, for all except the most urgent necessities, and they probably will hope for a while that they will be able to continue trading in the markets to which they are accustomed. We cannot, therefore, be too optimistic about getting all their trade, even were we prepared to handle it, which, except in certain lines of steel products, is doubtful.

Factors That Will Influence American Success in South America

A Statement from the Acting Secretary of the Department of Commerce

AN effort was made by this journal to secure the views of the Secretary of the Department of Commerce as to opportunities in South America. In his absence from Washington the following statement has been prepared for the Engineering Record by the Acting Secretary of Commerce:

South America is a growing market for American machinery and supplies. That this country will be called upon to furnish it more materials will be the natural result of the war now in progress in Europe; but the permanence of this business depends upon a change in certain factors that have worked much to the disadvantage of American manufacturers and exporters. Heretofore the countries of South America have looked to Europe for capital to develop their natural resources. This source of capital is now largely or completely cut off, and the result will be a curtailment of expenditures and the postponement of new enterprises until more auspicious times. The United States will profit, no doubt, through their necessity of getting supplies, but it should be borne in mind that purchases by South American countries will be limited to urgent needs.

European Capital in South America

The chief factor against the sale of American equipment and supplies is the fact that the source of capital for South American enterprises and the nationality of the engineers have largely determined where they shall be purchased. A project with German financial backing, carried out under the supervision of German engineers, is practically certain to use German materials, so far as they are available at competitive prices. In fact, in recent years it has become a practice for banks furnishing the money for such enterprises to stipulate the use of materials from the country in which the banks are located.

Investment of the United States capital in South America is small as compared with the amounts invested there by England, Germany and France. Hence, manufacturers of machinery and supplies in this country have been at a great disadvantage. A consular report from Brazil makes this significant statement:

Influence of Banks

"Unfortunately, there is very little American capital invested in railways or other public utilities in Brazil, and, while steam and electric roads are managed by Americans who favor American equipment, these managers cannot, in justice to their stockholders, place orders elsewhere than in Europe, everything else being equal."

The one country that seems to have been most successful in combining the efforts of bankers and manufacturers toward the increase of business and export trade is Germany. Back of the greatest electrical concern in Germany, for example, is a group of banks that furthers the interests of the combine in foreign countries by furnishing money for the development of various enterprises. The net result is that the money furnished by these banks is spent largely in the purchase of goods from the manufacturing companies with which they are allied.

Trade Follows Investment

Trade follows investment, and when the United States enters the foreign field of investment it will reap the benefits not only in interest upon the actual money furnished but also in increased sales of American goods.

It must be borne in mind that the financial resources of the great European nations are being rapidly exhausted by war. It is fair to assume that it will be many years before they recover from its effects. In the meantime they will have great industrial problems to solve at home, and investments in far-off South America will be far less attractive to their citizens than they have been in the past.

The time seems ripe, therefore, first, for a more liberal investment of the United States in South American development; second, for a very considerable business in operating supplies and in the equipment necessary for the completion of projects already begun; third, for demonstrating to the people of South America the satisfactory character of American apparatus. In common with other American-made goods, machinery and engineering supplies have been misrepresented by foreign competitors, and we ought to make the most of our opportunity to demonstrate their excellence. To take the fullest advantage of the present situation prompt and vigorous action on the part of our manufacturers is needed.

Statistics of South America's Import Trade

In the three tables of engineering imports on this page are presented statistics as to imports of leading engineering and construction materials into Argentina, Brazil and Chile in 1912. The figures are given separately for the United States, the United Kingdom, Germany and France. They indicate the possible field for American expansion in the three leading Latin-American countries. The tables have been compiled from data presented in a publication of the Department of Commerce, entitled "South America as an Export Field," written by Otto Wilson, commercial agent of the department.

Table 1—Engineering Supplies and Construction Materials Imported Into Argentina in 1912 from the Countries Designated

Articles	From United States	From United Kingdom	From Germany	From France	Total imports
Beams, iron	94,440	91,035	1,846,070	495,815	3,276,365
Brick, paving	8,375	98,520	153,625	109,400	1,055,840
Bridge materials	66,905	776,810	110,240	3,265	997,670
Cement, hydraulic	13,545	640,520	258,135	752,880	3,989,340
Dynamos and motors, electric	28,545	219,935	1,212,775	42,385	1,637,755
Electric wire and cable	102,885	1,205,515	1,227,695	96,465	3,087,700
Iron axles and wheels	87,685	1,156,005	7,750	....	1,256,735
Iron bars and sheets	408,135	656,150	2,489,430	80,800	6,288,590
Iron, galvanized	1,398,165	4,088,950	381,955	24,985	6,160,145
Iron, wrought	321,005	1,156,670	377,870	77,300	2,753,025
Locomotives	....	1,847,135	293,845	627	2,188,660
Machinery, general	1,119,225	2,022,795	2,572,365	459,975	6,939,140
Machines, spare parts	1,132,290	684,510	692,340	119,950	2,909,925
Manufactures of copper and bronze, n.e.s	100,795	402,430	281,845	144,120	1,073,095
Materials for port works, n.e.s	105	110,280	66,075	14,580	204,035
Materials for sanitary works, n.e.s	....	962,525	57,135	3,045	1,066,365
Motors—					
Windmills, with or without framework and pumps	372,580	13,980	555	....	393,275
Other, various	631,820	316,015	85,765	6,800	1,142,485
Pine, unplaned—					
White	1,728,450	140,350	11,773	23,160	2,130,015
Pitch	8,078,590	3,880	29,170	30	8,164,720
Spruce	1,662,050	76,925	50,635	14,065	3,689,605
Pipes, iron—					
Galvanized	229,180	966,955	83,565	3,205	1,294,550
Other	51,460	756,245	238,810	34,290	1,171,965
Railway freight cars	558,855	2,650,155	74,190	16,095	3,812,510
Railway materials	132,810	4,152,660	237,460	93,345	5,013,430
Sand for building	115	....	....	....	1,024,380
Screws and nuts	170,230	401,675	156,050	183,830	1,061,980
Steel rails	737,685	2,226,600	1,343,315	17,290	5,088,405
Tramway materials	107,725	506,110	599,020	20,920	1,668,460

Table 2—Engineering Supplies and Construction Materials Imported into Brazil in 1912 from the Countries Designated

Articles	From United States	From United Kingdom	From Germany	From France	Total imports
Asphalt	39,334	....	....	....	172,889
Belting	44,394	206,090	42,740	49,137	351,719
Railway cars	1,915,701	991,730	331,761	....	7,382,069
Axles and wheels for railway cars	271,653	268,616	431,786	....	1,328,604
Cement	275,942	1,138,048	2,525,183	117,025	5,263,961
Dynamite and other explosives	10,257	417,202	91,324	37,119	563,570
Electrical machinery	2,060,944	569,562	1,375,764	537,636	4,811,052
Iron and steel and manufactures of—					
Galvanized corrugated sheets	328,994	1,540,600	91,931	....	2,060,072
Bars, rods, plates and sheets	114,879	529,803	569,338	....	1,797,435
Cast, pig, and puddled iron	7,019	331,278	....	....	372,735
Locomotives	1,871,639	459,850	1,290,737	....	3,749,149
Motors and stationary engines	425,918	333,763	507,533	70,511	1,460,513
Machinery, industrial	230,799	2,776,668	1,784,057	354,519	5,758,613
Nails, screws, etc	117,401	143,478	116,929	80,627	547,469
Rails, Joints, etc	1,868,840	751,474	1,344,151	2,071,438	9,384,650
Scales	....	....	....	....	....
Steel bars and rods	94,276	518,345	81,098	....	944,537
Stills, boilers, etc	77,836	466,263	78,623	....	716,563
Structural material	196,928	648,719	1,223,603	384,630	3,099,101
Tubes, pipes, fittings	419,678	1,988,125	985,359	354,521	3,973,039
Tools	694,927	1,537,651	661,834	299,377	3,311,443
Telegraph poles, bridge and fence material	328,901	391,635	360,880	25,509	1,478,680
Pumps, hydraulic, and parts	92,776	118,906	86,698	....	365,636
Pipe, lead	1,776	45,491	....	....	51,542
Wood, and manufactures of—					
Pine blocks and boards	2,302,576	....	....	....	2,768,805
Staves and hoops	7,886	28,931	112,666	....	186,883
Rough, sawed, planed and veneered	33,123	....	25,621	....	464,835

Table 3—Engineering Supplies and Construction Materials Imported Into Chile in 1912 from the Countries Designated

Articles	From United States	From United Kingdom	From Germany	Total imports
Cars for portable and aërial railways	18,727	335,521	393,922	850,535
Cement, Roman	72,917	313,012	1,168,373	1,703,032
Iron and steel, and manufactures of	3,521,167	4,447,775	4,446,738	13,448,154
Pipes, tubes, tools, etc	152,906	813,813	568,463	1,883,638
Nails	216,655	58,493	205,515	525,819
Iron and steel, unworked, in bars, plates and other forms	240,183	149,994	413,660	1,153,087
Sheet iron corrugated, galvanized	967,402	776,490	4,150	1,748,128
Rails for railways	516,384	488,551	443,247	1,516,485
Locomotives and tenders	107,932	337,791	656,819	1,119,018
Machinery, implements, etc.—				
For arts and sciences	327,923	169,531	762,327	1,369,415
Mining	99,827	250,047	296,913	652,828
Industrial	226,647	867,627	1,049,792	2,345,184
Motors	81,737	1,022,549	304,967	1,471,558
Parts	153,672	494,480	613,277	1,122,020
Materials for Longitudinal Railway	316,032	148,954	301,036	666,022
Metals, other than iron and steel	155,706	840,196	932,125	2,249,211
Pine lumber, rough	1,252,359	76,335	3,079	148,949
Railway freight cars	13,205	187,866	62,022	430,473